Engineering and Mining Journal

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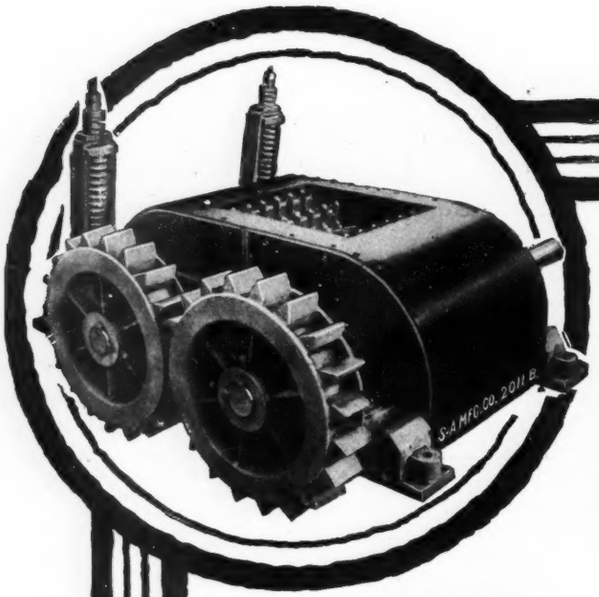

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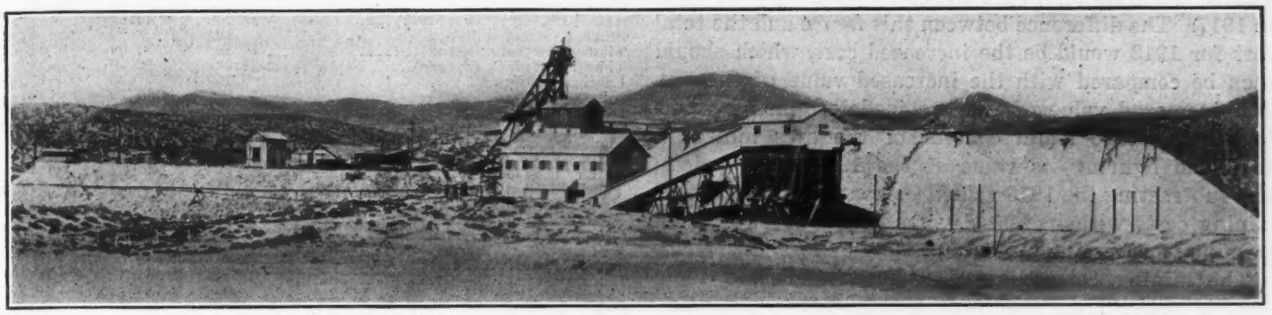
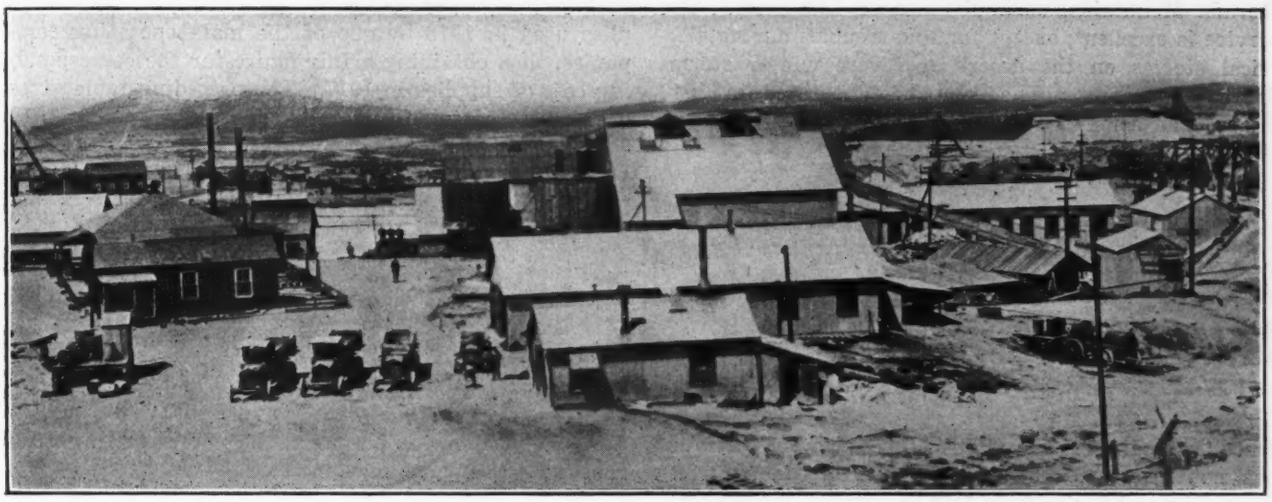


VICTOR SHAFT OF THE TONOPAH EXTENSION COMPANY



WEST END MILL, TONOPAH

Effect of the War Upon Tonopah Mining

BY JAY A. CARPENTER*

An interesting and comprehensive summary of the figures obtainable which refer to the increase in prices of labor and supplies, and to other expenditures connected with the mining and milling of the silver ores of Tonopah in 1913 and 1917, as compared with the appreciation in the value of the product during that period. Details of the operations of the five principal companies are given in tabulated form for these two years and the conclusion is reached that the increased costs of operation are almost wholly counterbalanced by the increased value of the product.

MINING engineers who visit the camp of Tonopah invariably ask the question, "What has been the effect of the war upon the costs of mining and realization of the profits of the operating companies?" The mine superintendent naturally dwells upon the subject that gives him the greatest concern, which is the increased cost and scarcity of labor and its decreased efficiency. The mill superintendent deplores the ever-increasing cost of supplies and the decreasing quality. The auditor complains of the doubling or trebling of the time checks coming to the office, and of the scarcity and slow delivery of supplies. The superintendent of a developing property is nearly driven to despair; whereas the stockbroker features the quotation of over $1 silver and declares that conditions at Tonopah are better than ever.

The object of this paper is to try to determine, by a study and comparison of costs between the years 1913 and 1917, whether a company producing the same tonnage of ore with the same silver content in both

*Mine foreman, Jim Butler Tonopah Mining Co., Tonopah, Nevada.

years would make a greater or less profit under the changed operating conditions of the present.

The best method of investigating this problem is to consider separately each of the three main divisions of mining costs—power, labor, and supplies; and after determining the percentage increase of each of these items in 1917 over 1913, to apply this increase to the power, labor, and supply costs of 1913, thus obtaining a fairly accurate figure for the corresponding total costs in 1917. The difference between this figure and the total cost for 1913 would be the increased cost, which should then be compared with the increased value of the ore. The increased value of the ore is determined by taking the average metal content of the ores milled in 1913 and figuring its value at the 1917 metal prices, and subtracting the 1913 value. Comparison of increased mining costs with increased value of the ore would determine whether the profit is greater or less.

The mining companies of Tonopah purchase their electric power from the Nevada California Power Co., whose hydro-electric power plants are in the Sierra Nevada Mountains, at a distance of 140 miles. The service is excellent, except for line troubles during electrical storms on the desert or severe winter storms in the mountains. The companies operated in 1917 under the same Public Service Commission power schedules as in 1913, and the cost of power therefore has not increased. With the larger producing companies the cost varies from 1.4c. to 1.2c. a kilowatt-hour.

Labor has received two advances of 50c. a shift since 1913, the first being in December, 1916, and the second in September, 1917. On the item of labor, the pay of the machineman in the mine or the batteryman in the mill represents closely the average daily pay to the men in the camp, as the lower pay of the common laborers is balanced by that of the more skilled men above them. In 1913 the daily wage of the machineman and batteryman was $4.50 a shift; and, in 1917, $5 for nine months, and $5.50 for three months, or an average of $5.12 a shift, which is an increase of about 14% in the cost of labor. The item of the decreased efficiency of labor cannot be expressed in percentage figures, but it can be expressed by the mine shift boss in very strong words. The reason for the change in efficiency is that in 1913 the high scale of wages in Tonopah, as compared with the copper districts, attracted a high class of labor, whereas in 1917 the best labor had gone to the copper camps.

The increased cost of supplies per ton of ore in 1917 over 1913 cannot be so accurately determined as that for power and labor. This is because of the great number of items to be considered, the wide difference in the percentage increase in the price, and the great variation in the amount used.

The best way to determine the increased cost of supplies per ton of ore is to tabulate, in percentage, the increased cost of the main supply items, and to apply that increased percentage to the amount of these supplies used in 1913 by one of the main operating companies, thus obtaining a fair figure for the corresponding cost of supplies in 1917. The preceding table gives a fair list of mine and mill supplies, with the 1913 f.o.b. Tonopah price per unit, the corresponding 1917 price, and the percentage increase.

VARIATION IN COST OF TONOPAH MINE AND MILL SUPPLIES

Item	Unit	1913 Cost	1917 Cost	Increase, %
Drill steel, ¾ in. hex	lb.	$0.1167	$0.2567	120
Blacksmith coal	ton	19.70	35.00	78
Air hose	ft.	.30	.45	50
Mine shovels	doz.	7.50	16.50	120
Powder	lb.	.145	.2325	60
Caps	case	50.00	150.00	200
Fuse	case	27.00	40.00	48
Stulls, 6 in. to 8 in. top	ft.	.10	.10	0
Timber and plank (native)	M	19.50	32.00	64
Timber and plank (Oregon)	M	24.00	38.00	58
Lubricating oil	gal.	.25	.28	12
Mine rail, 8 lb	ton	55.00	110.00	100
Iron pipe, 2 in	ft.	.12	.25	108
Hoisting cable, 1 in. plow	ft.	.22	.35	59
Manganese steel crusher parts	lb.	.145	.203	40
Battery shoes, chrome	lb.	.06	.085	42
Battery dies, local, cast	lb.	.035	.04	14
Tube-mill liner, local, cast	lb.	.053	.06	13
Danish pebbles	ton	33.00	55.00	67
Sodium cyanide	lb.	.25	.32	28
Sheet zinc	lb.	.10	.20	100
Lead acetate	lb.	.09	.165	83
Lime	ton	17.00	19.00	12
Borax glass	lb.	.136	.16	18
Soda ash	lb.	.036	.042	17
Crude oil	gal.	.04	.07	75
Filter canvas	yd.	.56	.70	25

OPERATIONS OF FIVE IMPORTANT TONOPAH

Company	Year	Mine Tonnage—Year	Mine Tonnage—Day	Value per Ton	Extraction of Values—Gross, %	Extraction of Values—Marketing, %	Extraction of Values—Net, %	Mining Costs—Direct	Mining Costs—Development	Mining Costs—Indirect	Total Cost
Tonopah Belmont	1913	172,398	473	$21.09	94.45	2.50	91.95	$3.01	$1.10	$0.41	$4.52
	1917	131,100	361	16.57	94.05	2.56	91.49	3.42	1.02	.60	5.04
Tonopah Mining	1913	163,387	448	17.79	89.00	3.26	85.75	.....	.....	1.06	4.02
	1917	101,978	277	15.47	93.30	1.40	91.90	.....	.....	1.07	5.91
Tonopah Extension	1913	58,022	159	12.00	88.40	1.60	86.80	.....	.....	.38	5.78
	1917	110,188	302	12.54	90.51	1.40	89.11	.....	.....	.....	5.26
West End	1913	52,838	145	18.70	91.30	2.60	88.60	.....	.....	.64	4.11
	1917	45,910	126	15.73	93.10	1.46	91.64	3.34	1.87	.58	5.79
Jim Butler	1913	18,900	52	19.80	....	....	90.00	.....	.....	.37	5.57
	1917	40,297	111	26.12	93.14	....	93.14	4.11	1.06	.73	5.90

The percentage increase at shipping points would be greater than shown on the table of f.o.b. Tonopah prices, because freight rates did not increase from 1913 to 1917. Owing to the geographical situation of Tonopah, freight plays an important part in the cost of mine supplies. An extreme illustration of this appears in the item of crude oil, which, in 1913, cost 1c. a gallon and the freight 3c., whereas in 1917 it cost 4c. and the freight remained at 3c.; thus the price f.o.b. shipping point, increased 300%, but the local price increased only 75 per cent.

Local Foundry and Use of Artificial Pebbles Effect Savings

The excellent foundry and machine shop of the Campbell & Kelly Co. has been of great value in prompt delivery and saving of freight charges on hundreds of tons of cast iron and semi-steel. This firm, after purchasing all the scrap iron and steel at a fair price, furnishes the greater proportion of the battery dies, battery and tube-mill liners, mine cars, mill pumps and repair-part castings used by the operating companies. The Maris pebble quarry, 40 miles from Tonopah, which furnishes an artificially rounded chalcedony tube-mill pebble of good wearing quality, has also been a help to the companies. The plant is running at full capacity,

and pebbles are being delivered in Tonopah at $25 a ton, whereas Danish pebbles are scarce at $55.

One of the operating companies, in 1913, subdivided its cost of mine supplies as follows: 12.4% for drill steel and repair, 14% for timber, 6% for pipe and track supplies, 50% for powder, cap and fuse, and 14.6% for other items. This is approximate, but it is a closer subdivision than most companies make. Usually the exact cost of a small item like lead acetate per ton milled is calculated, but no direct figure is obtained for an important mine item like timber. The underlying cause for this failure to record so important an expense is that the mill crew is interested in the storekeeper's work and results, whereas the mine crew considers the storekeeper a nuisance. Applying the increases of prices from the table as closely as possible on the limited subdivision cost figures given, the results are as follows:

Item	1913, %		Increase	1917, %
Drill steel and repairs	12.4	×	2.20	27.3
Timber	14.0	×	1.32	18.5
Track and pipe	6.0	×	2.00	12.0
Powder, cap and fuse	53.0	×	1.60	84.7
Other items	14.6	×	1.80	26.3
	100.0			168.8

This gives an increased cost of mine supplies of 68.8 per cent.

That is, the cost of mining should have increased, approximately, 30%. Taking the mill costs likewise:

Item	1913, %		Increase	1917, %
Power	16.0	×	1.00	16.0
Labor	25.0	×	1.14	28.5
Supplies	59.0	×	1.42	83.0
	100.0			127.5

Milling costs should have increased 27%. With 60% of the total costs as mining costs and 40% as milling costs, the total increase in total mining cost appears as follows:

	Cost		Increase	1917, %
Mining	60	×	1.297	77.7
Milling	40	×	1.275	51.0
	100			128.7

Thus the total cost of mining, under the assumption that the daily tonnage, metallic content of the ore, and mining conditions remained the same in 1917 as in 1913, has increased 28.7 per cent.

In Tonopah the ratio of silver to gold in the ore is nearly 100: 1; thus, for 1 oz. of silver there is 0.01 oz. of gold. The average selling price of silver for the Tonopah companies for 1913 was $0.595, and, in 1917, $0.85. The corresponding 0.01 oz. of gold sold for $0.206 at both times. The value for each ounce of silver, with its corresponding gold, in 1913, was $0.801, and, in 1917, $1.056, giving an increase in value of

MINING COMPANIES IN 1913 AND 1917

Mill Tonnage					Milling Costs						Increase, %		
Per Day	Oz. Gold	Oz. Silver	Price, Silver	Value, Ton	Direct	Indirect	Total	Tonopah Cost per Ton	Eastern Office per Ton	Total Cost per Ton	Total Cost	Profit	Tons of Ore per Ft. of Development
473	0.267	26.33	$0.595	$21.09	$2.56	$0.20	$2.76	$7.37	$0.32	$7.69	36.50	55.45	6.7
400	0.162	15.88	.8413	16.60	2.87	.22	3.09	8.13	.44	8.57	51.70	39.79	9.1
448	0.23	21.84	.....	17.79	2.59	.22	2.81	6.83	.59	7.42	41.70	44.05	9.1
277	0.163	14.19	.850	15.47	2.92	.33	3.25	9.16	.34	9.50	59.1	32.80	...
159	0.15	15.00	.....	12.00	2.58	.40	2.98	8.76	.17	8.93	74.40	12.40	3.6
302	0.117	11.77	.86	12.54	.....	.....	3.21	8.47	.39	8.86	70.60	18.51	10.0
145	0.227	22.72	.595	18.70	2.97	.21	3.18	7.29	.15	7.44	39.80	48.80	7.7
183	0.206	19.70	.830	20.51	2.79	.21	3.00	8.79	.24	9.03	57.40	34.24	6.0
52	0.27	23.75	.....	19.80	6.23	1.04	7.27	12.84	.08	12.92	65.40	24.60	...
111	0.285	25.20	.806	26.12	5.33	.71	6.04	11.94	.36	12.30	47.1	46.0	8.0

A similar method of figuring the milling supplies results as follows:

Item	1913 Cost Per Ton	%		Increase	1917, %
Zinc	$0.19	12	×	2.00	24.00
Cyanide	.70	41	×	1.28	52.50
Lime	.03	2	×	1.12	2.24
Lead acetate	.04	2	×	1.83	3.66
Fuel oil	.09	5	×	1.75	8.75
Shoes and dies	.03	2	×	1.30	2.60
Tube-mill liners	.08	5	×	1.13	5.65
Tube-mill pebbles	.11	6	×	1.67	10.00
Water	.17	10	×	1.00	10.00
Other items	.28	15	×	1.50	22.50
	$1.70	100			141.90

This gives an increased cost of mill supplies of 41.9%. In 1913 the proportion of costs of the four large companies for mining and milling was 60% for mining and 40% for milling. Mining costs were divided into, approximately, 6% for power, 64% for labor and 30% for supplies, and the subdivision of milling costs was 16% for power, 25% for labor and 59% for supplies. This is an interesting division, because it shows that the cost of power is a minor charge, whereas labor is the predominating item in mining, and that supplies are the principal factor in milling.

Item	1913, %		Increase	1917, %
Power	6.0	×	1.00	6.0
Labor	64.0	×	1.14	73.0
Supplies	30.0	×	1.69	50.7
	100.0			129.7

Taking mining costs of 1913, and applying increases for 1917, the result appears in the preceding table.

32%. From these data it is evident that the increased cost of power, labor, and supplies from 1913 to 1917 has about equaled the increased value of the metal content of the ore.

The method adopted in calculating the increased total cost of mining in 1917 over 1913 results in a more reliable estimate than can be obtained by the study of a table of comparative mining costs, compiled from annual reports, because the tonnages mined, the width and depth of orebodies and the grade of ore vary greatly with each company in the years to be compared. However, such a table is herewith given, not only for the sake of comparing the operating costs between the pre-war and war times, but also to serve as a comparison with silver-mining costs elsewhere; and the data should be useful to engineers acquainted with the local peculiarities of the Tonopah properties, as it affords a direct comparison of their respective costs.

Each company has its own peculiar form of report, and consequently it is a difficult task to standardize costs as shown in this table, which is based on a fair knowledge of the properties and a careful study of their annual reports. Although it may contain minor errors, it is, in the main essentials, correct.

The total tonnage milled in 1917 by the leading four companies was 13% less than in 1913. The average silver content of the ore dropped from 22.4 oz. to 14.4 oz., a decrease of 35.7%. The 35.7% decrease at a 32%

increase in value gives only 85% of the gross value per ton in 1917, as compared with 1913. If the cost of mining had actually increased 28.7%, the margin of profit would have been only 19.4% of the value of the ore, instead of 44.6%, as in 1913. However, the margin of profit in 1917 was 24.8% of the value of the ore, owing to the fact that the actual cost of mining in 1917 increased only 16.9% over the figures for 1913. This does not mean that the figure of 28.7% increase, as deducted above, is an incorrect value of the increased cost of mining, but indicates, rather, that the difference between 28.7% and 16.9% is the measure of the savings made by the companies over operating conditions in 1913.

Not all the operating savings are favorable, for in 1917 the amount of development work per ton of ore milled was considerably less. This was due, in some cases, to the fact that there was not so much virgin ground left for development, and, in others, to the scarcity of good machinemen and muckers. Where it cost one company $6.40 per ft. to drive crosscuts in 1913, it cost $8 per ft. in 1917. In this connection, it is interesting to note that the labor increased 15%, the expense for power was unchanged, and supplies 50%, giving a total increase of 25%, which closely checks the cost of the increased figures mentioned previously as showing the increased cost of mining.

Effect of War Not Altogether Adverse

Another reason for the lower actual percentage of increase of total mining costs is the fact that Tonopah companies carry large storehouse accounts. Many materials are kept on hand for months ahead of actual requirements or else purchased on contracts made during the year previous. Therefore, in 1917, a part of the supplies used was charged out at 1916 prices.

However, there is another factor that must be given its credit, and that is the better supervision over labor and supplies that is now exercised on all the properties. The practice, in these war times, of a hard day's work, and the will to save materials and supplies, extend from the superintendents to many of the workmen.

The Tonopah Extension, which is now mining on the 1580 ft. level and sinking the shaft to 1700 ft., showed, taking all things into consideration, a creditable decrease in underground mining costs in 1917 over 1913. Likewise, in milling, the West End mill came out with a slightly lower milling cost in 1917 than in 1913, with practically the same silver content of ore, and only a small increase in tonnage. The net extractions of the milling plants increased from 88.3% in 1913 to 91% in 1917, the best showing being made by the Tonopah Mining Co.'s mill, which jumped from the lowest to the highest net extraction. The Jim Butler Co. shows high milling costs, because all its ore has been shipped to a custom mill at Millers. The average total cost of mining increased from $7.70 a ton in 1913 to $9 in 1917, with the Tonopah Belmont having the lowest cost, $8.13.

Estimated Results for 1918

Although 1918 figures are not available, the increased costs are a source of worry to the operators. The item of power will remain the same as in 1917, but many commodities are still advancing in price, and, with 1917 contracts and supplies running out, the cost of supplies for the last half of 1918 will show a marked increase—and supplies are more than 40% of the total cost. The cost of labor will be 7.4% higher than in 1917, and the new draft law will make workmen scarcer than ever. The price realized for silver will probably average $0.97, which will give an increase of 11.1% to Tonopah's 100 to 1 product, as compared with 1917. Supplies would have to increase 20% in value in 1918 as compared with 1917, in addition to the 7.4% increase in labor, to balance the increased price in silver. This is hardly possible, although the 25% increase in freight rates will bring total costs close to this figure.

To sum up the conclusions as to the effects of the war upon mining in Tonopah: The increase of total mining costs up to 1917, under similar conditions as in prewar times of 1913, has about equaled the increased selling price of Tonopah's silver and gold product, and the increased costs of 1918 will again be just about balanced by the increased selling price of silver.

Gold Mining in Ontario, Canada

Considering the handicaps under which gold miners are operating, the output of 229,421 oz. for the first six months of 1918—a small increase in production as compared with the first half of 1917—is a creditable showing, says an Ontario Bureau of Mines report. In the Porcupine camp, the Dome, Porcupine Crown, Porcupine V.N.T., and Schumacher have ceased milling operations. The Crœsus, in Munro Township; the Tough-Oakes, at Kirkland Lake, and the St. Anthony, at Sturgeon Lake, are in the same category. This curtailment of output is offset by the new producers of gold—Lake Shore, at Kirkland Lake, and Davidson, at Porcupine. The 40-ton mill of the Patricia Syndicate, at Boston Creek, started operating the latter part of June. A promising vein carrying gold telluride has been discovered on the Miller Independence, at Boston Creek. Shaft sinking is proceeding and arrangements are being made to increase the milling capacity at this property. Considerable activity at Boston Creek has resulted from these developments. In the new Matachewan camp, from the claims under option to the Nipissing Mining Co., some spectacular samples of gold ore have been secured. Diamond drilling on the Otisse claims is said to be producing satisfactory results. During the period the Porcupine camp produced 207,731 oz. of gold and Kirkland Lake, 17,927. A total of 515,094 tons of ore was milled, with a recovery in gold and silver reported to be valued at $4,692,529.

Hold Your Liberty Bonds

It was a wise and patriotic old colored American who refused to sell his $100 Liberty Bond for $96, because he would not give up the United States' promise (his bond) to pay him $100 with interest for the United States' promise (currency) to pay him $96, and who refused to sell the same bond for $102 because, he said, the $102 must be counterfeit or else the would-be purchaser would not be willing to give it for only $100. It is safe to assume that there are no gold bricks or wildcat securities among that American's assets.

The Jerome District of Arizona—Part II*

By J. R. FINLAY†

AT THE United Verde mine, the orebodies are in a large slab of greenstone schists, in horizontal cross-sections resembling a rude crescent, which pitches downward between its enclosing intrusives, in a northwesterly direction, at an angle of perhaps 50 to 60°. The diorite covers this slab of schist with a concave surface like an inverted Spanish tile, and the quartz porphyry forms a rough pitching floor. If the included schists were removed, there would be an enormous cavern going down steeply to the north.

The schists which fill the space that I have thus attempted to describe have been the channel of an intense mineralization, so that a considerable part of them has been converted into ore. This ore consists essentially of quartz, pyrite and chalcopyrite. The thing that attracts the eye is an enormous mass of iron pyrite, occupying a cross-section of nearly if not fully 10 acres, rudely circular or elliptical in outline, but irregular. The quartz and chalcopyrite are mingled with this mass in varying amounts. Near the center of the pyrite mass there is not, as I understand it, much quartz, although the amount increases toward the periphery; but this arrangement is far from regular. The chalcopyrite is the ore. The mass of the pyrite contains only one-quarter of 1% copper—being practically barren—but certain portions of it contain chalcopyrite in varying amounts, so that large lens-like masses attain a copper content ranging from 2% up to 15 or 20%. These are the orebodies. Chalcopyrite also occurs in the schists around the periphery of the pyrite masses and also makes orebodies. The ores contained in the pyrite mass are called iron ores; those consisting of chalcopyrite disseminated in the schist are called siliceous ores.

Narrow Dioritic Dikes Cut Orebodies

These broad features are unmistakable, and may be regarded as thoroughly established; but, as a matter of detail, the occurrence of the commercial ore, as distinguished from the mineralization as a whole, presents many eccentricities that are not wholly understood. The orebodies are cut by several narrow dioritic dikes, known as water courses. These are usually considerably bleached, even in the lowest levels, far below the influence of any alteration proceeding from the surface. This would seem to indicate that the dikes have been altered by the mineralizing agencies. On the other hand, there is no evidence that they have been replaced by the ore minerals. It seems reasonable to conclude, therefore, that they came in during the latest stages of the mineralizing process. These dikes have a strike which may be generalized as about N 70° W; and many observers have concluded that the dikes may have followed a zone of fissuring which might have existed earlier and have been followed by the mineralization. If this was the case, there is little evidence of it in the orebodies themselves, for the minerals now form a solid mass in which preëxisting structures have been obliterated as completely as in a stock of granite.

But away from the centers of intense mineralization, in the Jerome Verde and United Verde Extension mines, some fissures have been noted that bear in the same general direction as the water-course dikes and are distinctly, though not heavily, mineralized. This lends color to the idea that a zone of fissuring may have had much to do with establishing the mineralizing channels.

New Mineralized Area Developed

The United Verde Extension mine has in recent years opened up a mineralized area about two-thirds of a mile east of the United Verde. Ignoring for the present other interesting facts about these occurrences, there is reason to believe that they are part of the same zone as the United Verde. But the structural arrangement is still indistinct, because the development is only partial and because all of it thus far is in the zone of oxidation or in that of secondary enrichment, in both of which the rocks are greatly altered by kaolinization. In the immediate neighborhood of the orebodies, therefore, it is hard to distinguish some of them. It seems, however, that some of the smaller orebodies follow the contact of a great wedge-shaped mass of diorite between the quartz porphyry and the green schists. These ores are between the diorite and the schists. But the great orebody of the Extension mine is not so easily described. It is at the point or edge of the wedge of diorite and is surrounded apparently on all sides by quartz porphyry, but is near the contact of that rock with the green schists. Moreover, it lies apparently at the intersection of two interesting mineralized faults, one of which strikes about N 65° E and the other about N 70° W.

It is evident that in the region of the big orebody the United Verde diorite is invading the contact between the quartz porphyry and the green schists, but whether the diorite follows a preëxisting fault, or whether the faults are later than the diorite, is very obscure. The mineralization is intense over an area of several acres, in the central part of which an area of an acre and a half is a solid body of chalcocite and pyrite averaging 17% copper.

It is rather early to generalize about orebodies that are so meagerly developed, but it looks as though the vast masses of pyrite, which are a sort of matrix for the orebodies of the United Verde, are comparatively small in the Extension mine. Low-grade pyritic masses have been encountered, it is true, but thus far they are relatively insignificant, and it is not improbable that they will continue so even in the zone of primary ores. If this proves to be the case, it will only mean, in my judgment, that the Extension orebodies are more distinctively copper mineralizations than those of the United Verde. In the latter mine, the copper ores seem to have been introduced after the formation of the main pyrite masses. The later copper-bearing mineralization is probably identical in both mines. There is no reason to believe that the United Verde Extension bonanza was any richer as originally deposited than some of the individual orebodies at the United Verde; but it

*Conclusion of paper published Sept. 28, 1918.
†Mining engineer, 45 Cedar St., New York.

does seem probable that, in the Extension, the proportion of copper to the total volume of iron is very much higher. So far as can be judged at present, the two deposits are about equal as copper producers. Even making all allowances for the effect of secondary enrichment, it is doubtful if the United Verde orebodies contain more copper, if as much, per vertical foot, as those of the Extension.

Another point of great economic importance is the fact that the two parts, or halves, of the district are separated by a great fault. On the hills above the United Verde, the flat-lying sandstones and limestones of Devonian age begin to appear at an elevation of 6050 ft. The fault has an average strike of N 37° W. East of this is a bench, on top of which the same sandstones and limestones lie almost perfectly flat, but their bottom is at an elevation of 4350 ft. The vertical displacement is, therefore 1700 ft., and in this bench lie the Extension orebodies. Other faults occur further east, dropping the Palæozoic formation to a still lower level, so that by the Verde River, at Clarkdale, only three miles away, the pre-Cambrian floor is only 2000 ft. above sea level. None of these faults except the big one at Jerome has raised the pre-Cambrian rocks to the surface. East of that fault they have remained buried since the invasion of the Palæozoic sea. It is all but certain that in the succeeding ages, including the present era, they have never emerged above the groundwater level. They are, therefore, preserved intact, having suffered neither oxidation nor erosion since the day they were buried. On the United Verde side, however, the great recent fault exposed the pre-Cambrian rocks in an escarpment 1000 ft. high above the bordering bench. This escarpment has been beveled off by recent erosion. Above the United Verde mine, 600 ft. of the orebodies has been removed by this erosion, including nearly all of the original oxidized zone. The primary sulphides in places come up to the present surface.

Now, the oxidation plainly acted more vigorously in the larger orebodies than in the smaller ones, and the copper migrated further. If there had been smaller orebodies in the vicinity of the United Verde, the enriched portions, as well as the oxidized zone, would have been swept away, leaving only the ores of the primary zone at the present eroded surface. A small vein carrying 3 or 4% copper would not be valuable. On the other side of the fault, such small veins are still intact, oxidized zone, enriched zone, and all. In the enriched zone they carry fair bodies of chalcocite, running 15 to 45% copper. Such small veins are, therefore, valuable and make a pleasing adjunct to the big ones.

Great Amount of Low-Grade Ore in United Verde

As in other districts where rich ores occur in abundance, the operators have naturally preferred to mine those rich ores in preference to poorer ones. It is, therefore, difficult to form an idea of the average grade of all the merchantable ores. It is certain that large amounts of low-grade ore, say from ½ to 2½% copper, occur in the United Verde mine. Some of this material goes into the shipping product, inevitably, because the miners cannot always keep it out, but no effort has been made to utilize it. How much there is of it, how cheaply it can be mined, the extent to which it could be concentrated by flotation, are all unsolved problems, and any assertion about them would be pure guesswork. However, I regard it as probable that in the course of time it will be found desirable and practicable to concentrate some of the low-grade ores; and the life of the mines will be greatly prolonged by so doing.

Output From United Verde Mine

At present the United Verde mine is able to ship to its smeltery an assemblage of ores, practically all primary, averaging about 5% copper and yielding about 90 lb. copper, 1½ oz. silver, and 35c. gold per ton. It may be assumed that this grade was much higher in the eariler years of the mine and that it has slowly declined. It is probable, however, that by careful mining the grade may be maintained at its present level for a number of years, although it is planned to increase the output to 1,000,000 tons a year, increasing the present tonnage by about 25%. This will mean that the output of copper will rise to 90,000,000 or perhaps 100,000,000 lb. a year in the near future. The assurance that this can be done is furnished by the discovery of a large body of high-grade chalcopyrite ore in the lower levels of the mine, from 2100 to 2500 ft. below the original pre-Cambrian surface. This orebody, I understand, runs about 10% copper, and a large section of it, opened for stoping, has averaged nearly 13%. A cross-section of the orebody near its middle would apparently cover at least an acre.

On the United Verde Extension side, 202,477 dry tons of ore had been shipped up to the end of 1917, entirely from the richest part of the zone of secondary enrichment, from which the actual yield has been about 104,000,000 lb. copper, 375,000 oz. silver, and 7000 oz. gold. The grade of ore, as shipped, has averaged about 27% copper, 1¾ oz. silver, and 70c. gold per ton. It is not believed that such ores can be shipped much longer, but there is no reason to suppose that the grade will go below 10% copper for a number of years. In fact, one may be fairly certain that the first 2,000,000 tons mined will average 15% copper. If this rate is maintained, with, say, 10,000,000 tons of United Verde ore over a 10-year period beginning in 1915, the date of the opening of the Extension mine, the average grade for the district for that length of time will be not less than 6⅞% copper. This is high-grade ore, considering that it is obtained without sorting of any kind; but it is no richer than the average of the Bisbee district to date. When one considers the fact that this ore is being mined at depths varying from 400 to 2500 ft. below the pre-Cambrian surface; that none of the mines is exhausted at any level; that the Extension mine has no development at all more than 800 ft. below the pre-Cambrian surface, and almost none below 600 ft.—that, in fact, the exploration of the zone east of the fault is hardly more than well started—it may reasonably be expected that these mines will make a big output and have a long life. In 1917 they produced 135,000,000 lb. of copper, and are being equipped to produce 150,000,000 to 200,000,000 lb. a year. There is no reason to suppose that such an output will put an undue strain upon the ore reserves. Thus Jerome, which for 25 years was an isolated and obscure camp, is now becoming an important producer. I shall try to give some idea of the community as an industrial and mining center.

Up to the present, from an output of something less

than a billion pounds of copper, the two mines of Jerome have paid $50,114,000 in dividends. They have also built, out of earnings, two large smelteries, a considerable length of railroad, extensive tunnels and mining equipment, two or three rather important industrial towns, completed or under way, and have, no doubt, large amounts of cash in the treasury. A rough computation of the operating earnings up to the end of 1917 is not less than $80,000,000. Of this, perhaps half has been earned during the exceptional years 1916 and 1917 from an output of 225,000,000 lb. There is good reason to suppose, however, that the earnings on 700,000,000 lb. during normal peaceful times were about $42,000000, or 6c. per lb. There is also reason to believe that if the output of the last two years had been made in normal times, with a price of 15c. per lb. for copper, the operating profits would have been $20,000,000. Thus, I believe the past history of the camp indicates an average operating profit of about 6½c. per lb. and a cost of about 8 to 9 cents.

It appears that up to the end of 1915, the United Verde mine had been able to pay $36,397,000 in dividends in a period of 21 years, during which the price of copper had averaged 14.3c., the production being fairly uniform at about 35,000,000 lb. a year. Five cents has been available for dividends, leaving a net cost of 9.3c. per lb. to cover all expenditures for mining, smelting, development, construction of railroad and smeltery, general expenses, and increase of working capital. The net yield per ton has probably averaged about 100 lb. copper, 1½ oz. silver and 40c. gold. The average value of the precious metals figures down to about 1¼c. per lb. of copper, so that if the average price of that metal is 14.3c., the total value of the bullion will be 15.55c. On this basis, a liberal allowance for all expenses, both for operating and capital, on a total output of 700,000,000 lb., has been 10.05c. per lb. The cost of converting, refining and marketing the bullion may be estimated at 1.85c. per lb., leaving 8.2c. per lb. for all other expenses.

United Verde Extension Possibilities

Apply these figures to the extraordinary bonanzas opened by the United Verde Extension, in which 2,000,000 tons of ore can be counted on to run 15% copper and to yield 290 lb. copper, 1½ oz. silver and 60c. gold per ton, with operating methods equally efficient as those of the United Verde. The value of this bullion is 14.8c. per lb. Deducting 1.85c. per lb. for converting, refining, and marketing, there remains 12.95c. per lb. The mining, smelting, construction, and general expenses will be, as before, $8.20 a ton, to be divided by 290 lb. copper. This is equal to 2.83c. per lb. Deducting this, there remains 10.12c. per lb., which should be applicable to dividends. I can see no flaw in this reasoning, although the result appears extraordinary.

It is fair to believe that the total output of copper, 580,000,000 lb., according to this computation, would be extracted in 10 years, and that dividends of $60,000,000 would be paid in that time, leaving the mine intact for further development and a complete equipment. Under these circumstances, it seems to me that the investor is warranted in figuring that the $60,000,000 profits expected in 10 years is a conservative and guarded basis for valuing the property; that he might assume a 5% net return, plus return of capital, to be sufficient for a property so guarded, and that he would have important speculative probabilities in addition. Under these circumstances, it is computed that the property possesses a valuation of $45,000,000.

The "speculative probabilities" refer to the discovery of additional ores. There is likelihood of such discoveries, both laterally and in depth. Exploration in depth has gone down only one-third as far below the original surface as in the United Verde, in which mine bonanza ore occurs in the very bottom. There has been some apprehension that the great Jerome fault might interrupt these orebodies at some point below the present workings in such a way that the downward continuation of them might be found on claims owned by the United Verde. It is entirely possible that this may happen, but it is not at all certain. In the first place, nothing is known of the dip of the fault within a distance of 1500 ft. Within such distances even the largest faults frequently make considerable turns, both in strike and in dip. This particular fault at a short distance south of the Extension mine makes a turn from a course of S 37° E to due N and S, and then makes another sharp swing around to S 60° E. A turn in the dip of the fault opposite the orebodies much less than either of these would render intersection out of the question. As a matter of fact, the fault has changed its course from the points at which it was noted northwest of the mine, for otherwise it would already have intersected the orebodies. How great the swing may be is as yet uncertain.

Orebodies Have Dip Parallel to or Away From Fault

In the second place, the orebodies may have an average dip, or pitch, parallel to the fault, or away from it. There is a considerable probability that this is the case, for some orebodies at the northwest end of the Extension mine have evidently been cut by the fault. They appear on the hanging-wall side, but there is no trace or indication of them on the foot-wall side, although the rocks are well exposed by erosion and by extensive underground workings. It seems probable, therefore, that these orebodies have a dip flatter than the fault plane, that the upraised ends have been destroyed by erosion, and that the portion on the depressed side continues downward undisturbed.

In the third place, it is certain that no intersection has occurred above a point 800 ft. below the pre-Cambrian surface. If the orebodies go down vertically and the fault plane continues on its apparent dip, the orebodies cannot be completely cut off above the 1600-ft. level (2400-foot level of the mine) below the pre-Cambrian surface. This would leave the main orebody intact to an average depth of 600 ft. below the lowest explored level. This is a minimum.

If, therefore, the probabilities as they appear at present are weighed, it does not appear that the danger of the fault impairing the value of the mine is either great or imminent. At most, it will only disturb the "speculative probabilities." At a guess, one might say that it reduces them by a third in the case of the present orebodies. There are good chances of finding ore in territory to the southeast of the present mine, where the danger of displacement by faulting is nil.

Before ending the discussion of the pre-Cambrian de-

posits which have proved so valuable at Jerome, it will be interesting to note the extension of the same formations to the southwest. At Jerome itself there is merely a narrow point of a wedge of pre-Cambrian, raised up through a cover of Palæozoic sediments by faulting, aggregating in vertical movement 4000 ft., which has taken place along a zone a mile and a half wide. It is thus upon the escarpment of an important recent mountain uplift. The Palæozoic formations at Jerome present two peculiarities that are worth noting:

1. The series begins with the Devonian, at least that is my supposition. The lowest limestone is known to be Devonian, and between it and the pre-Cambrian complex there is only about 50 ft. of sandstone. Ransome assumes that this sandstone corresponds to the Tonto sandstone (Cambrian) of the Grand Canyon, but I take this to be merely a slip of the pen. It is hardly possible for a few feet of sandstone to carry with it any presumption of equivalence in age with some other sandstone that looks like it. Each invasion of the sea produces a basal sandstone by reassorting the weathered débris on the land surface. Such a basal sandstone merely marks the sea transgression, and the same one might, and no doubt does, mark the progress of the sea upon higher and higher levels of a continental area through a series of geologic ages. In the absence of determining fossils, the age of such a sandstone should be assumed to be that of the contiguous rock overlying, if that is determinable.

Now, throughout Arizona there are usually some Cambrian strata in the Palæozoic column, but the Ordovician and the Silurian are generally wanting. Ordinarily, there is no angular unconformity between the Cambrian and the Devonian, in spite of the huge time gap represented by the absence of the Ordovician and Silurian. To explain this, one has only to remember that in Russia, along the Gulf of Finland, Cambrian and Ordovician strata are still unconsolidated sand and clay. They have lain there through interminable ages without change, distortion, metamorphism, or even hardening, because the earth's crust in that region has remained still. It is entirely conceivable that, around Petrograd, Quaternary strata may be in contact with and in apparent conformity with the Ordovician.

Interesting Geologic Facts and Deductions

In Arizona the absence of unconformity between the Cambrian and the Devonian must mean simply a long period of quiet, with gentle oscillations of level, and no deposition; certainly no mountain building, and no deep erosion. In Devonian times there followed a general immersion in the sea of this whole region. By this time the neighboring lands, wherever they were, must have been worn down so flat that they could furnish little or no Clastic sediment, for the Devonian rocks are almost pure limestones. From Cananea to Grand Canyon and from Tucson to Clifton, and no one knows how much further in all directions, there was a sea of clear water of moderate depth, and full of corals and coral reefs.

An interesting question which may be solved some time is whether the highlands southwest of Jerome may not have been an island in this Devonian sea. The absence of strata older than the Devonian and the strong inference that there had intervened no considerable disturbance or erosion, which was likely to have swept away such strata in pre-Devonian times, point decidedly to the conclusion that there was comparatively high land at the site of Jerome which the Cambrian sea did not reach. This naturally brings up the question whether the slope may not have continued in some direction toward a *massif* high enough to remain an island even during a large part, or all, of the succeeding submergence.

Assuming that the Devonian strata were originally level, it is possible to calculate that the pre-Cambrian surface at Jerome was originally 1000 ft. higher than the same surface at Grand Canyon, there being that amount of Cambrian strata under the Devonian at Grand Canyon and none at Jerome. The same facts appear in comparing the sections of Bisbee, Ray, Globe, and Roosevelt Dam (Ransome). As all these places lie toward the southeast, east and north, it is easy to explain the facts by a depression along an axis lying northeast of Jerome, and therefore approximately under the edge of the plateau region. If this is true, it is logical to assume that the land surface sloped upward toward the southwest. How far this slope continued, or to what height, one has no means of knowing, except that there is good reason to believe that in Devonian times the slopes were gentle, erosion was slow, and no large rivers were debouching near enough to muddy the waters.

2. The Palæozoic strata are found at the very top of the Black Hills (the mountain block on the edge of which Jerome stands), but they merely lie on the outer rim of the uplift, and do not continue toward the southwest for more than a mile or two. They appear to feather out. There is no indication of their having been broken off by further faulting.

I do not refer to this fact as evidence of the thinning out of the Palæozoic deposition in that direction. That conclusion must be based on broader facts than those I am pointing to. It appears that the edge of the Palæozoics occurs as fragments of an arc of a curve the radius of which is about 25 miles, and its center some distance southeast of the town of Prescott. The fragments of this arc are found on the crest of the Black Hills west of Camp Verde and east of Prescott, thence northwest along the crest of the Black Hills to near Jerome Junction. At Jerome Junction there is a gap, but just north of that place the edge of the Palæozoics may be covered up with recent lavas. Six miles west of Jerome Junction the Palæozoics appear again in a strong ridge running west. All along the rim of this arc the strata dip gently away from the center.

Practical Importance of Geologic Considerations

I think there is warrant for believing this structure is the remnant of a dome or arch that was formed in Tertiary times, if not earlier, and extensively eroded long before the occurrence of the big faulting at Jerome or the late Tertiary volcanic activity of the region. If the Palæozoics be projected along their dip into the Prescott region, they would be found thousands of feet above the present surface. In the area now under consideration, this means that the original pre-Cambrian land surface does not exist in the sense that it exists at Jerome—i.e., intact but buried—but that there does

exist, instead, a new erosion surface scored down more or less during long geologic ages extending back perhaps to the Devonian, and continuing, with probable interruptions, to the present time.

I believe these observations to have practical importance, for without them it would be difficult to understand the deposits of the Prescott region, or to have any logical conception of the relationship between them and those of Jerome. The present surface of the scored dome just described is strewn with much recent lava, probably of the age of the San Francisco peaks. There are also many remnants of older volcanics, or intrusives, many of which are too fresh and undisturbed to have participated in the intense mountain-building activities of pre-Cambrian and pre-Algonkian time. There may be many igneous rocks of ages anywhere from Permian to Tertiary. Some of the ore deposits which have been worked in this area, off and on, for the last 50 years, may be derived from these comparatively recent intrusions. I suspect this to be the case with the copper mines at Copper Basin, about eight miles southwest of Prescott.

The Mayer Copper Mines

The far more important and promising copper mines near Mayer, 20 miles southeast of Prescott, are patently pre-Cambrian and are not to be explained as emanating from later igneous activity. The largest mine in this district, the Blue Bell, is 30 miles south and 10 miles west of the United Verde, and about 20 miles west of the nearest Palæozoic rim. The original pre-Cambrian surface in this locality has undoubtedly been scored down at least 2000 or 3000 ft., but the exact amount I have no present means of estimating. If, therefore, these deposits may be assumed to have had about the same relation to the pre-Cambrian surface as those of Jerome (a mere assumption certainly, but let it go at that), one must conclude that the Mayer mines represent a deeper-seated stage of mineralization.

I must disclaim any detailed knowledge of this region. My chief interest has been to notice some of the broader considerations which, it seems, must be taken into account before it is possible to understand the rather mysterious ore deposits of this important field. I shall merely set down a few remarks for what they are worth.

In the Mayer district the rocks are known as Yavapai schists. They appear to be ancient surface volcanics for the most part, mainly greenstones of about the composition of diorite or diabase. There are no doubt plenty of intrusives mixed in. The copper deposits all occur in some quartz porphyry dikes which cut the greenstones and strike about N 10° to 15° E. Many of these rocks have been subjected to an extraordinarily energetic squeezing, which has produced in all of them a schistosity that strikes N 28° E. It is so strong in places that the quartz porphyry looks like a light colored and very fissile slate.

Though general, the schistosity varies in intensity. In most places the quartz phenocrysts in the porphyry may be plainly seen. This strong schistose structure has often imposed on the imagination of observers, many of whom have believed the Yavapai schists to be sedimentary. But that is not to be considered, for besides the optical evidence that the rocks are igneous, the quartz porphyries are plainly dikes, irregular in outline and throwing out branches. The schistosity is the same in kind as that of Jerome, but greater in degree. The strike of schistosity at Mayer is N 28° E; that of Jerome N 10° to 20° W. This swing in the direction of cleavage may be of considerable geologic significance, indicating, for instance, the locus of the forces that produced the schistosity and perhaps the ore deposits.

There is one important difference between these deposits and those of Jerome—there is no United Verde diorite or anything like it. The orebodies are all within or on the contacts of the squeezed dikes of quartz porphyry. In all other respects they are similar, but smaller and not so rich. The Blue Bell mine has produced to date about 600,000 tons of ore, and has 500,000 tons more in sight above the 1200-ft. level. In 1917 this mine shipped about 120,000 tons of ore, averaging a shade over 3% copper and $1.50 per ton in gold and silver. About half this ore is concentrated; the other half is massive pyrite, much like that of the United Verde. The Blue Bell orebodies are easily mined, the cost of mining under present conditions being a little over $3 a ton, including development. On a return to pre-war conditions this cost would be reduced to about $2.25 per ton, delivered to the railroad. There is no apparent reason why such ores should not be valuable under normal prices.

Operations of Consolidated Arizona Smelting Co.

The industrial center of this district is the Consolidated Arizona Smelting Co.'s plant at Humboldt, a few miles north of the mines, which is producing about 2,000,000 lb. of copper per month. Some of this comes from the United Verde Extension and will be cut off as soon as that company's smeltery is completed. The Consolidated Arizona Co. owns the Blue Bell mines, already mentioned, and another smaller one, called the De Soto. It also smelts the ores from a third mine, the Arizona Binghamton, which is said to be developing favorably. It would seem that from these sources a continued output of 15,000,000 to 20,000,000 lb. a year may be expected.

In all this discussion of the Jerome and contiguous district, I have gone only slightly into the details of cost. The fact is, the district displays little of special interest in this respect, and the reports of the mining companies give meager details. The striking features are precisely those already dwelt on: the geology, the big faults, the rich concentrations of ore, which allow low unit costs for copper without much regard for costs per ton mined; and the corollary that successful mining is largely successful exploration. In the whole area considered there are seven or eight mines that have dealt with deposits such as those described. Of these, two are wonderful bonanzas. The others are either mediocre producers, like the Mayer mines just mentioned, or immature prospects, some of which have produced sparingly, like the Jerome Verde, Jaeger Canyon and a few others. One, the Copper Chief, southeast of Jerome, is working, for gold, the oxidized gossan of a large pyrite deposit which has proved unprofitably low in copper. In addition to these there are many prospects, some of which are mere wildcats and others genuine enterprises testing various theories as to the location of possible extensions of mineralized areas.

In all this fervor of exploration, a detached and unprejudiced observer may find one lesson worth noting, namely that exploration of new ground for possible ore deposits demands the same attention to adequate equipment and adequate finance as the mining of ores actually found. Vast sums of money have been squandered through loss of time and failure to accomplish the work planned—by trying to make two horsepower equal four horsepower. Shafts too small and too insecure, hoists that will not raise the load from the required depth, pumps that will not handle the water, result finally in no room for ventilation, injury to health of the men, and meager results; and often the whole job, instead of being a question of drilling holes and breaking rock, becomes a blind and useless struggle with bad air, broken pipes, rotten timber, heat, water and mud.

The spectacular development and success of the United Verde Extension are due almost wholly to good prospecting engineering. The project had been going on in some such fashion as that described in the preceding paragraph for I don't know how many years. It had been started with enthusiasm, but with little calculation, by a man named Fisher, on a small fraction called the Little Daisy, right on the great Jerome fault. A shaft had been sunk 800 ft. through this fault into hard quartz porphyry. All lateral workings had to go out through the fault again. A winze had been sunk, again along the fault, to the 1200-ft. level. All this work had dug up some indications of ore, but the practical result was failure and discouragement, and the enterprise was considered to be a mere wildcat.

When James S. Douglas and George E. Tener decided to undertake the prospect, they applied common sense to the situation and came to a sound conclusion. It would cost $250,000 to explore the ground, anyway, and this amount of money, spent in a safe shaft with good equipment, would accomplish the work more cheaply and quickly than it would if spent in the old shaft. They accordingly sank a new shaft 1400 ft. in a central location in solid rock. When they struck ore, they were able to ship it immediately in good volume. Their new shaft was sufficient, as things turned out, to make an output of 63,000,000 lb. of copper a year, and to make profits at times exceeding $1,000,000 a month. That part was luck, of course, under any interpretation of that rather uncertain word; but good management consists of so acting that when luck comes your way you can make the most of it. I suppose that if no ore had been found, the level-headed gentlemen who created the mine would have been pointed to as victims of overconfidence—a renewed warning against (some phase of) the danger of building a mill before you find a mine. The indictment would have been false. They took a true measure of the job as a piece of pure prospecting.

Abolishing Concentration and Amalgamation for All-Cyanidation*

Interesting data are afforded by the recent publication of the results of treatment in a milling-in-cyanide plant where amalgamation has been abolished. Previous milling operations showed that 86% of the gold could be concentrated in about 7% of the tonnage. Tests on the 93% remaining, constituting the tailing after amalgamation and concentration, showed that this could be reduced to 45c. per ton by crude cyanide methods, and apparently without further grinding expense. These results would seem to indicate the lines along which a successful scheme of treatment might be formulated.

The 45c. residue was, however, considered discouraging, and further experiments on a sand of normal fineness for leaching purposes were apparently not considered. Tests were then made to see how much gold could be dissolved by an agitation treatment, and the results indicated that all the gold was soluble provided grinding was carried far enough. "Extractions" of 99.7% were obtained in the laboratory; and as a result of these tests it was decided to grind and regrind the 7% of the concentratable material without separation from the 93% of low-grade ore, a plan which provided that every particle of worthless rock and absorbent colloid should be thoroughly steeped in as rich a solution of gold as possible.

The fact that all the gold is soluble in cyanide is reaffirmed, but actual results would seem to indicate that from 40 to 50c. per ton remains in the residue from about 400,000 tons treated by an all-sliming, milling-in-cyanide process.

If the question of the further recovery of gold from the residue is considered, it must be realized that the 7% of material which might have been concentrated for special treatment is now intimately mixed with a large tonnage of gangue, and that any additional treatment of this residue may be deemed impracticable by known methods of handling. Even if the ratio of concentration was reduced to 10:1, there would remain argument in favor of the isolation of the special product. A dump of 400,000 tons of residue carrying about 40c. per ton in gold is valueless. A dump of 40,000 tons of clean pyritic concentrate carrying about $2 per ton in gold is a valuable asset in sulphur content as well as gold.

Tests on the concentrate in question showed that 96% of the gold could be extracted by straight cyanidation, and apparently without previous roasting, or amalgamation during regrinding. Practical results on pyritic concentrate invariably show that roasting reduces the cost of subsequent grinding and lessens cyanide consumption. Sulphur is urgently needed now, but "up-to-date" methods for treatment of a simple gold ore involve not only the loss of the pyrite but a recoverable percentage of gold associated with it. By concentrating the pyrite and recovering the sulphur, the gold is actually liberated, and the highest possible percentage may then be recovered.

The foregoing example adds weight to the contention that after milling in cyanide and all-sliming the actual residue value is not by any means in inverse ratio to the solubility of the gold in cyanide solution, but rather in direct ratio to the amount of gold which is permitted to pass into solution and become intimately associated with the worthless constituents of the ore. Practical results go to prove that a comparatively high percentage of such soluble gold may be lost in the residue after what are often termed "improved" methods of ore treatment.

*Excerpt from an article on "Milling in Cyanide Solution," by A. W. Allen, Met. and Chem. Eng., May 15, 1918.

Mining in Alaska Under War Conditions

BY P. C. STOESS*

A steady drop in Alaska's mineral production is forecast if present conditions in the territory continue. Many copper properties are idle, and gold producers are in even worse straits than those in the United States. Companies producing tin and chrome ore are somewhat better off, but, nevertheless, are handicapped. Financing new propositions is difficult, and labor shortage is acute, owing to enlistments and the draft, as well as to the call of shipyards and canneries. Ship shortage and restriction of ore shipments by smelteries in the United States have further hindered mining in Alaska. Miners there have been liberal to the Red Cross and to war funds.

FOR a comprehensive consideration of mining conditions in Alaska, the territory may be divided into three great sections, namely, Southeastern Alaska, Southwestern Alaska, and the interior. The principal production of Southeastern Alaska, embodying the islands and strip of mainland from Ketchikan to Skagway and the head of Lynn Canal, is gold from quartz mines and copper ores. Efforts have recently been initiated to produce zinc ore, molybdenum, and ores of platinum and palladium on a small scale.

Southwestern Alaska comprises Prince William Sound and its tributary countries, the Cook's Inlet districts, including Willow Creek, and the Alaska Peninsula. This section produces copper ores chiefly, and some gold, and contains the Matanuska and Katalla coal fields, as well as large coal deposits in the Peninsula, that have not yet been worked. In addition to these minerals, some oil is produced at Katalla. A small amount of placer gold and deposits of oil, sulphur, pyrite, and chrome iron are also known to exist to the west.

This interior of Alaska, known locally as the "Inside," covers the great valley of the Yukon and its tributaries from the American line to the mouth, and includes the extreme northwestern coast of Alaska, Nome and the Seward Peninsula. This section produces chiefly placer gold, though placer tin is also mined there on a small scale; and, until recently, efforts were made to open deposits of tin, tungsten and antimony.

In considering the present position of Alaska it will be well to remember that during 1916, the last year for which reasonably accurate statistics of production are available, Alaska produced metal from its ore and placer mines valued at more than $52,000,000, divided as follows: Gold, $16,329,437; copper, $35,314,933; antimony, $179,635; tin, $110,333; and tungsten, $83,370. Statistics for 1917 apparently are not available in detail, but the opinion appears to be that gold production has fallen off by over $1,250,000, and that copper production dropped in value to $24,000,000. Part of this reduction in copper is probably due to the difference in price, as throughout the last quarter of 1917 the price was fixed by the Government at 23½c. During the first nine months it fluctuated widely, but averaged, as near as can be determined, 27 to 28 cents.[1]

Southeastern and Southwestern Alaska, though divided geographically and commercially by about 400 miles of open water, and though practically uninhabited territory, are more or less identical in respect to mining operations, and the commercial conditions in the communities in these two sections are sufficiently closely allied to permit of their being considered together in this connection. Formerly, in the copper-ore producing districts of Southeastern and Southwestern Alaska, there would be no difficulty in finding at least 30 to 40 or more shipping mines, prospects in course of development, and others, all being worked with more or less energy.

At the present time, throughout the entire coast districts of the two sections, including the Nizina-Copper River district, which can be considered as tributary to Prince William Sound, fewer than 16 copper properties are being worked, according to information available. Of these, two mines are operated by one company; three smaller properties by another large company; two others have been on a paying basis and operating on their present scale for several years past; three more are shipping intermittently small amounts of ore and developing slowly at the same time; and the rest are small operations where development is carried on as it is possible, in a more or less desultory manner.

There are a number of promising properties which contain orebodies of a grade good enough to ship direct, carrying from 5% to 8% copper, but which are idle for several reasons, soon to be explained. Although these properties cannot be compared with the big copper deposits of the country, in some instances their development may open up fair-sized mines. In any case, they promise an output of from 5000 to 15,000 tons, and one property should produce more than 30,000 tons, under present conditions; and the conclusion is inevitable that they should not be lying idle. In Southeastern Alaska there are also a number of properties in the same or similar condition, but requiring equipment to permit ore to be shipped. All are now idle.

PLACER GOLD MINING AFFECTED AS ELSEWHERE

In the "Inside" or placer-mining district, the majority of the large low-grade gold producers are either shut down or closing because of the same conditions that are affecting gold mines all over the country. The richer drift mines and the dredging operations, as well as a few hydraulic mines which have a margin of profit of over 100% above ordinary costs of operation, are still working, but with much reduced profits, and it is likely, unless some action is taken to help gold production, that next season will see the majority of these shut down. The few placer mines in Southwestern Alaska near the coast are affected in much the same way. The large lower-grade operations are being suspended until conditions will permit the properties to

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[1]The average price of copper during the first nine months of 1917 was 28.407c., according to statistics published in the "Journal" of Jan. 19, 1918.—EDITOR.]

be worked at a profit. A few, possibly three or four, higher-grade hydraulic mines are being worked under the same disadvantages that are handicapping the interior properties.

In the entire Southeastern and Southwestern Alaska districts, it may be estimated that formerly there were always at least 50 to 60 mines and prospects working or being developed and producing gold or gold concentrates from quartz. At the present time, careful inquiry shows there are not more than 17 gold-quartz operations being carried on, including paying mines, leases, properties in course of development and equipment, and small prospects being developed in a desultory way. This includes the great gold-producing district of Juneau and the two other sections, namely, Willow Creek and Prince William Sound, which have produced fairly well, considering the investment and other conditions surrounding operations.

Conditions as to Other Minerals Poor

Respecting other minerals, conditions appear a little better balanced, though they are far from satisfactory. The quartz mines north of Nome carrying tin ores, which it was hoped would be in operation by this time, are still idle, though the tin dredges are said to be working. The bulk of the antimony and part of the tungsten ore mined in 1916 came from near Fairbanks, where there are a number of what are reputed to be promising deposits which carry these metals. Up to about 18 months ago, these were all worked in a more or less desultory manner, though probably insufficiently financed. The effort, nevertheless, was being made to get results, and some ore was being shipped under difficult conditions, which, however, can be improved. The present situation in the Fairbanks district is that efforts to mine antimony and tungsten under existing conditions have practically ceased, and most of the properties are idle.

On the other hand, however, a deposit of chrome ore is being opened up in Southwestern Alaska, on the coast, of sufficient value and in a sufficiently businesslike way to promise an operation of commercial importance during the coming year. In Southeastern Alaska, a deposit of molybdenite is being developed as rapidly as possible. From 150 to 175 men are now employed on this particular work. Incidentally, in the same district, a small deposit of copper ore was found to contain commercial quantities of platinum and palladium, and work on this is being pushed with a crew of about 20 men as rapidly as conditions will permit. Some effort is also being made to work a zinc-ore deposit in Southeastern Alaska, but at present details as to its success are not available.

Money and Labor Hard To Obtain

Considered as a whole, Alaskan mining operations are suffering from much the same conditions as those which affect mining work all over the United States and Canada, save that in Alaska these conditions are somewhat exaggerated. The first thing that stands out strongly appears to be the inability, as a general rule, of the mine owners, or of any one else, to obtain sufficient money to bring any given property to a point where it can be self-supporting. The few who have been looking for properties in Alaska in recent years have sought for immense deposits of ore already opened up. This, of course, can hardly be expected in a new country, such as Alaska, particularly in view of the general apathy toward the pioneer end of mining during the last eight or nine years. Consequently, little new work has been done in Alaskan mines for some time, if exception be made of a half dozen large enterprises.

The scarcity of labor has become a more serious obstacle in Alaska than elsewhere. During the period between 1914 and 1917, when the United States entered the war, a large number of Alaskans volunteered for the British service. Later, when it became inevitable that the United States would be drawn into the conflict, and immediately after it did enter and before the draft law was passed, the younger men poured out of Alaska in a constant stream, until the entire number which would be required by the draft had volunteered. Then the draft law went into effect, and a similar number again was drawn from the population.

Shipyards and Canneries Lure Labor Away

In addition to losses from the draft and through volunteering, there is a further large percentage of the seasonal workers in Alaska who make their homes in Seattle, Tacoma, Portland and San Francisco; who ordinarily could be counted on for work in Alaska each year, but who have also either volunteered or been drafted. Furthermore, the call for skilled workmen of all kinds in the shipyards on the Pacific Coast has made additional inroads on the labor supply available for Alaska.

Again, one must consider the seasonal demands for fishing and cannery purposes, which affect the coast districts mainly. A large number of new canneries and fish salteries were established along the Southeastern and Southwestern Alaska coast in 1917 and 1918, and these have obtained a number of laborers from the mines, as the pay is better while it lasts. As an instance of this, the case of a man who with a small boat earned $9 in less than five hours catching fish for one of the canneries in Southwestern Alaska may be cited. Ordinarily, working at a mine, he would be able to earn not more than $5.50 for an eight-hour shift.

Miners' Wages No Better Than in the States

It is to be noted that in Alaska the miners receive no more, and in some cases a little less, than is being paid at Butte, or in the Arizona mining camps producing copper in the United States, if the reports available in technical and business journals are correct. The general effect of this labor shortage in Alaska has been to slow up everything and to raise wages from 40 to 60%. The large copper mines have been working for some time with short crews. One property is using 350 men and should have 200 more, but cannot get them. Another is working approximately 250 and could use another 100 men. One of the smaller operations, but a regular shipper, normally employs from 65 to 70 men and has a crew at present of about 40. On the other hand, however, the small copper producers, shipping intermittently and having small crews from six to 35 men, are having no serious difficulty at present, as there always seems to be a class of men available who prefer a small camp to a large one, however attractive the conditions may be at the latter.

The same labor shortage exists at the gold mines, but is more serious, as these cannot afford to pay the wages offered by the copper operators. In the entire Juneau district there are at present fewer than 750 men employed. This is not due entirely to the rate of wages paid, however, as, wherever it is possible, work is being done by contract, which enables the men to get the same pay as or possibly a little more than they could earn by the day in copper or other mines. Under normal conditions there should be at least from three to four thousand men working in Juneau. The operator of a small gold mine employing approximately 40 men stated that he not only had difficulty in getting men for his work at the higher wages, but also that the average skill of the men available was not up to the former standard, which, of course, is to be expected when all the facts are considered.

The cost of mine supplies and food has practically doubled throughout Alaska, as well as on the greater part of the Pacific Coast, this in itself forming a severe handicap, particularly to the low-grade quartz mines of Juneau and the big low-grade gravel deposits of the interior, as may be readily understood. In a general way, as near as can be determined, the increased cost of labor and supplies has raised expenses of operation all over Alaska, on an average, not less than 75% and, in many cases, more than this amount.

Ship Shortage Has Injured Mining

The mines which ship ore by water, in common with Alaskan communities, are suffering from the shortage of ships, which, coupled with the immense traffic which has been going on now for three months and will not be over until the end of September, owing to the need of moving the fish pack to market, is causing great inconvenience. In some cases, it will probably result in financial hardship to the mining community, as several properties find themselves with their ore bins full and are prepared to take out further bodies of ore, but have been unable to ship all summer, as vessels have not been available for this purpose.

Though there are nine boats on the run between Seattle and points in Southeastern Alaska, and five more running to Southwestern Alaska and covering most of the Southeastern run as well, and five or six freight vessels, the conditions have been more or less chaotic all summer. Juneau has at times been for 10 days at a stretch, during the summer months, without receiving mail or passengers from the South. Similarly at Valdez and other southwestern points during a period of 21 days, in July, no boat of any kind arrived from the South, the returning boats being likewise delayed. All this means that the business of shippers of copper ore and gold concentrates is being held up.

Smelters Have Restricted Ore Shipments

Another thing which does not encourage mining operations in Alaska is the smeltery situation, which a year and a half ago was admittedly unsatisfactory with regard to the ore being offered. At that time, for their own protection, the smelters buying ore on the coast were obliged to put restrictions on shipments, which have not as yet been entirely removed. To add to this condition, the supply of siliceous ores from South America, used to smelt with the iron base ores of Alaska, has been cut off to a great extent, on account of the lack of tonnage. This, therefore, will enforce a reduction of shipments of the iron base ores, which have composed a large part of the Alaska shipments. On the other hand, it may later encourage the opening of siliceous base orebodies available in the territory.

A new concern, backed by people in Ohio, has moved during the last two years to reopen the old Ladysmith smeltery, on Vancouver Island, which it was thought would relieve the situation to some extent. But to date, though the smeltery has been run intermittently for short periods, its operation does not appear to hold any immediate promise of relief. As a matter of fact, should any concern open up a new mine that would produce 300 to 500 tons of copper ore per day, it is doubtful if an immediate outlet or market could be found for it on the Pacific Coast. In any event, even if the Ladysmith smeltery should be reopened, unless it is enlarged and further refining facilities on the coast are established, the capacity will always be limited by the refining capacity of the Tacoma smeltery, where practically all the copper from smelteries on the North coast is refined. Therefore, any new smelting operation producing crude copper, or making a matte, must depend on the capacity of the Tacoma smeltery refining plant, as it is impracticable under present conditions to ship elsewhere.

Development of Coal Industry Lags

Coal mining in Alaska can hardly yet be said to have become an industry. A small amount of coal has been mined in a desultory manner on Cook's Inlet and used locally. The Federal Government has about 300 men working at three different mines in the Matanuska coal field, but is operating with a short crew all the time. This work is in charge of Sumner S. Smith, formerly Federal mine inspector for the district. Its utility will depend entirely on the completion of the Government railway to Seward,[2] which has been retarded because of the shortage of labor.

At present ships coming south from Anchorage are loaded to capacity with laborers of all classes. Three ships which left Anchorage within 48 hours of each other recently brought out 450 persons from that point A party of men in charge of an engineer has recently been sent into the Katalla coal field with a view to laying out and beginning a coal operation there. According to report, a branch line is to be built from the Copper River & Northwestern Ry. to the Katalla field as soon as possible. It is said that this operation will be substantially backed and will be pushed by private interests.

The oil fields at Katalla are doing fairly well in a small way, and are producing most of the fuel used on the fishing boats and small vessels in and around Prince William Sound.

Mining Situation Summarized

As to the mining situation in general in Alaska, it may be said that the tendency is to close down all independent small operations, unless they have unusually substantial backing by interests that can afford to keep

[2]The completion of the Government road from Anchorage to Seward has recently been announced by the Department of the Interior. Coal may now be shipped direct from the Matanuska field to Seward, 190 miles away.—Editor.]

them going until their objective is reached; also to concentrate the important operations in the hands of very large corporations. New developments have ceased and there are few if any new properties in the course of being opened up. This condition applies over almost all of the Northwest. Operations of the individual prospector or group in developing mines with moderate or small means are constantly becoming scarcer. This does not make the outlook hopeful for the future, as it is rarely that the big operating concern opens up a new mine in a new district unless some one else has first proved it.

The net effect on mining in Alaska in 1918 of the present labor and cost situation, together with the other items mentioned, will be to reduce the gold output considerably. Though it is early in the season to say how far this reduction will go, the general opinion seems to be that the gold output will be cut to at least 40% of last year's production and probably more, which means that for all Alaska it will not be likely to exceed $9,000,000 in 1918. Unless something is done to assist the gold miners materially, and give them the same benefits of a higher market for their product that producers of other metals obtain, the gold production for 1919 will drop still further, until it will be cut down to two or three million dollars per year. Could some form of encouragement be given to the gold miners, it is likely that Alaska can produce from 18 to 20 millions a year, provided, also, that all the skilled men are not drafted for Army work.

Copper production certainly will not increase and is likely to drop from 10 to 15% below the figures for last year. This shortage can hardly be attributed to unfavorable conditions respecting the ore deposits of the country, but must be charged to circumstances which have arisen as a result of the war and which are felt rather more in Alaska than elsewhere. The further increase in the price of copper may possibly assist the production of that metal and encourage additional work at the smaller mines carrying higher-grade ores, and so improve the situation.

Alaska Miners Liberal to War Funds

It should be recorded here that Alaska has been practically drained of mining engineers, assayers and surveyors under 40 years of age not directly employed by the large companies, and their crews are likewise more or less affected by this exodus, as the younger men have been called into the service. But in spite of the difficult conditions under which people in Alaska are operating, there is less kicking, as a rule, against the inconvenience caused by war conditions than is heard at other points on the Pacific Coast, and Alaska is contributing not only men but money on the most liberal scale, in proportion to her population. It may not be generally known "outside," but it is a fact that, at practically all mining camps, the men are contributing a day's pay every month to the Red Cross, and are averaging over $150 apiece in Liberty Bonds, in addition to buying war savings stamps and so on, in which they are making a good showing.

It is to be hoped that the Post Office Department will be able to make arrangements in the near future which will permit the mail to go forward, under proper supervision, as it formerly went. A few weeks ago the contracts offered for carrying the mail to Alaska were all refused, and as a result the mail clerks were taken off all the boats, and mail is now being sent to Alaska by freight, which is adding just a little more to the difficulties of operations in the territory.

Crystalline Graphite Production

The shipments of domestic graphite of the grades known as No. 1 and No. 2 flake in the first half of 1918 amounted to 1683 short tons, according to figures compiled by H. G. Ferguson, of the Geological Survey, from monthly reports submitted by the producers. Of this amount 1142 tons came from Alabama and the remainder from New York and Pennsylvania, except small quantities shipped from California, Montana, and Texas. It is estimated that more than two-thirds of this graphite was used for making crucibles and that the remainder was used chiefly for making high-grade lubricants.

The actual mine production of flake graphite during the first half of the year was nearly 2000 tons. A continuation of shipment at the present rate will give a total production for the year approximately equal to that of 1917. It is believed, however, that as crucible manufacturers are now using larger quantities of domestic graphite in their mixtures—20% or more—the demand will increase during the next few months.

The following figures, compiled from the records of the Bureau of Foreign and Domestic Commerce, show the imports of crystalline graphite in 1917 and in the first six months of 1918. Graphite entered as imported from France is credited to Madagascar, and that entered as imported from Great Britain, British India, and the Dutch East Indies is credited to Ceylon: 1917—Ceylon, 24,575 short tons; Madagascar, 4393; Canada, 3476; Brazil, 18. First half of 1918—Ceylon, 6674 short tons; Madagascar, 524; Canada, 1763; and Brazil, 40. It is assumed that one-fourth of the Canadian imports and 90% of the imports from other countries represent graphite of crucible grade. The imports of crucible graphite in 1917 were therefore about 27,000 short tons, and those of the first half of 1918 about 7000 short tons.

Magnesium Production Large

Metallic magnesium, which is commonly used as a flashlight in photography, is used also in aërial bombs and rockets for lighting battlefields at night. Burning magnesium makes a dense pure-white cloud, and the metal is put into shrapnel shells so that observers and gunners may know exactly where the shells are bursting. The result is a veritable cloud by day and a pillar of fire by night on the European battlefields.

Magnesium is made by the Norton Laboratories, Inc., at Lockport, N. Y.; the American Magnesium Corporation, Niagara Falls, N. Y., and the Rumford Metal Co., Rumford, Me. Reports made by these three companies to the U. S. Geological Survey show a production of 50,384 lb. of metallic magnesium in the first quarter of 1918, and 66,554 lb. in the second quarter, making a total of 116,938 lb. in the first half of 1918. The total production in 1917 was 115,800 pounds.

Pisé de Terre Mine Buildings*

The development of new mining districts involves building operations on a commensurate scale—an expense which is often avoided on account of the uncertainty of the life of the district. The same consideration affects new settlements which have sprung into existence following the expansion of war industries in hitherto unoccupied regions. The use of adobe is perhaps fairly well known, but the system here described, in the practice of which the walls are made of rammed earth, indicates that dwellings and other buildings can be erected at a low cost which will compare favorably, in regard to both comfort and convenience, with the more expensive structures that are sometimes considered necessary.

THE cost of buildings in many mining camps is often a serious consideration to those concerned; and operators and workmen on small properties frequently live for years in uncomfortable huts rather than face the expenditure involved in erecting better and more lasting types of dwellings.

Attention has previously been directed in technical and other publications to the method of building with rammed earth, or pisé de terre, a system in itself very old, but adopted only in isolated instances. The great advantage of pisé de terre work is its low cost. Houses or sheds built of adobe or rammed earth have to pay little or no tribute to the transport trades. All materials for the walls are found on the spot and may be taken from the field in which the buildings are to stand. For this kind of wall building only unskilled labor is required—the greater part of the house can be built by those who are going to live in it.

Pisé de Terre Buildings in Rhodesia

Pisé de terre buildings have been used as habitations in Rhodesia for a number of years and have proved efficient. The following is a description of one of the methods of construction adopted:

Boxing is required for molding the walls, and this is made of four pieces of deal each 12 ft. x 9 in. by 1½ in. These are spiked together with cleats in pairs to make two boards each 18 in. wide, which form the sides of the box between which the walls are rammed. End pieces of correct width are fixed between the boards for the required thickness of walls, which should not be less than 14 in. for walls 12 ft. high. Each end piece is held in position by four small iron plugs, two on each side, passing through holes drilled near the end of the planks and entering partly into end pieces. When setting up the frame for ramming the walls, it is held in position by three clamps, placed with their legs vertically downward over the frame at equal intervals apart. The clamps are shaped like a right-angled U, made of timber or iron, and for a 14-in. wall would be 17 in. across, inside measurement, with legs about 18 in. long. If the clamps are made of timber they should be H shape, so that a cleat can be nailed across the arms projecting above the form, to give rigidity. These prevent the side boards being spread during ramming, and to hold them apart three distance pieces are required at the top.

For joining up interior walls and corners of outside walls, a right-angle frame is necessary, but this can be constructed easily. The only other items required for construction of the walls, except a few tools which are generally available, are a plumb and level, a sieve, a few nails, wooden rammers about 3 in. in diameter which can be cut from bush timber, and hoop iron or wire. In some cases it may be advisable to put in a rough stone foundation, but if the ground is firm and well drained all that is necessary is to level off the site.

Details of Construction

The material used for the walls in one instance is one-third sand, one-third ant heap and one-third soil, all pulverized and put through a sieve. Water is then added. The mixture must be neither too wet nor too dry—just sufficiently damp to bind; a good indication of the correct consistency being that when squeezed hard by the hand it shows a tendency to bind. Sufficient of the loose mixture is thrown into the form to fill it to a depth of about 3 in., and this is well rammed before the next layer is put in. Thorough ramming is essential. When the frame is rammed full, it is taken apart and shifted along to make another section, and so on until the first layer is complete. The first layer is, as a rule, sufficiently dry to permit the starting of the next about three hours after laying. In the second and succeeding courses, the framework is supported by three or four pieces of stout wire or nails which have been laid into the previous course about 1 to 2 in. from the top and projecting outward about 1 in. These are drawn and the holes plugged when the frame is removed. Holes are bored in the planks to allow for this projection. One end board must be left out, as the frame at that end embraces the part of the wall already laid, and it may be necessary to use an additional clamp here. Door and window frames are put in as the work proceeds, and must be well braced while ramming. In the top layer, hoop iron or fencing wire is let in for fastening down the wall plates. Arsenite of soda may be used in the first layer or two to keep out white ants. The floor can be made of timber, cement concrete, or rammed earth, and the roof thatched or covered with corrugated iron, as is most convenient.

Concrete Floor Optional

Should a cement concrete floor, which is cheaper than a wood one, be desired, there would be an extra expenditure for cement, the amount required being about two bags for each 12 sq.yd. Such a floor should be laid before the walls of the building are begun; and it is essential that the site be thoroughly well rammed and consolidated, particularly beneath where walls will come, before laying the concrete, to prevent cracks developing as a result of settlement. The concrete mat should be carried at least 6 in. beyond the outside walls

*Excerpts from the 1918 report of the Rhodesia Munitions and Resources Committee.

of the building; and if the work is properly done, a special ant course will be unnecessary. The concrete can be left rough below the walls to give a bond, and it might be advisable to lay some pieces of hoop iron in it which would be left projecting to be bedded on to the walls. Another good type of floor is one constructed of road material, laid down and tarred in the same manner as roads are now made in many places.

A number of rooms and houses have been erected on the Globe & Phœnix mine on much the same principle as pisé de terre buildings, but the system developed there is different as regards the mixture, which consists of two parts of ant heap or ordinary clay, which must not be too sandy, and three parts of ashes or clinker sieved free from fine dust. It is interesting to note that the walls are made waterproof by first smoothing them with clay plaster, and then, when entirely dry, giving one good coat of boiling hot tar. A coat of limewash is applied three days later. That this is effective is well evidenced by the fact that the buildings erected have successfully withstood an abnormally heavy rainy season.

Buildings at the Globe & Phœnix Mine

The Globe & Phœnix system is the result of a number of experiments carried out at that mine. The mixture employed, which is said to be ant proof, contains more moisture than pisé de terre, and each course is reinforced with old wire rope or other suitable scrap. The material is left in a heap for one or two days before being used. Circular huts have been built of the same material, the forms being made of two rings of corrugated iron in three or more sections, joined up with cleats at the end laps and held in position with cross bolts and distance pieces. The inner ring is 9 in. less radius than the outer one.

A point of interest is that ceilings for rooms, of the same material, have been successful at this mine, the method being described as follows: For a 14 x 12-ft. room, place 4½ x 3-in. seasoned timber ceiling joists at 2-ft. centers, resting on wall plates at the ends, and in the center on a 6 x 4-in. beam. Frame a strong pair of rafters over the center of the ceiling, and hang up the center of the beam with a ¾-in. kingbolt. Fix 3 x 1 in. battens flat on top of and at right angles to ceiling joists, also at 2-ft. centers; cover the whole area over these with small-mesh wire netting and, between the joists, with temporary close boarding. Then cover the whole with a layer of the mixture 4½ in. thick. Do not close in the roof until the ceiling is dry; then remove the close boarding underneath, smooth over and treat with limewash.

Advantages and Scope

An advantage which a pisé de terre house would have over the ordinary type of dwelling in many climates would be in its capacity for heat conservation in winter and greater coolness in summer. In localities where the heat is excessive in summer time, the walls could be made thicker than 14 in., at a practically negligible extra cost; and a ceiling of the Globe & Phœnix type would add greatly to the comfort, although some extra expenditure would be necessary for material needed.

There would appear to be an extensive field for buildings of the pisé de terre type, and they should appeal to many who live outside town areas. Rentals are usually high, on account of the cost of building material. Cheap pisé de terre huts could be put up for temporary residence, and more permanent quarters erected when and as conditions created the opportunity.

Siberian Mines

Developments in Russia, it is announced, says the *Statist*, have placed the properties of the Irtysh, Kyshtim and Tanalyk companies outside the zone of Bolshevik influence. No damage has been done to the properties, order is being restored, the Bolshevik decrees of nationalization, confiscation or expropriation have become inoperative, and the directors have reason to believe that steps are being taken to remove any restrictions imposed. It is important to bear in mind that the properties in southern Siberia, especially the Irtysh Corporation's Ridder concession, are relatively not far from the Chinese frontier, as distances are measured in that part of the world. Railway disorganization, inability to obtain supplies, and financing difficulties were first responsible for discontinuance of operations, and no doubt it will be some time before matters in this connection are sufficiently improved to permit resumption of work. However, the importance of metal production to the Allies operating from the East, and the relative proximity of the properties to the Trans-Siberian line to Vladivostok, are factors which point to an easier settlement of difficulties than thought possible only a short time ago. In this connection also the appointment of Sir Charles Eliot as British High Commissioner in Siberia, with diplomatic rank, may also have influence, in view of his knowledge of Eastern languages and his close acquaintance with the customs of Asiatic races.

Hongkong Tin Active

Business in tin for the first five months of 1918 was very brisk, according to Consul A. E. Carleton at Hongkong. So far as Hongkong prices are concerned, 1918 may be considered a record, and there is no special reason to believe that the present prices will change materially for the remainder of the year. On Jan. 1, the local stocks were about 1500 tons, and the total quantity imported into the colony from Yunnan for six months is estimated at about 6000 tons. America and Europe have taken about 6500 tons, the greater portion being for the United States, and China coast ports and Japan about 850 tons.

The price per picul in the middle of May reached $182 Mexican, and when the year began the price was about $103 per picul. At the end of June the price in Hongkong stood at about $134. The stock of tin in Hongkong was low in June, and as a result little business was done. The following declared exports of this consulate general show shipments to the United States for the six-month periods of 1916, 1917, and 1918 as follows: 1916, 5,282,828 lb., valued at $1,122,242; 1917, 9,112,931 lb., valued at $3,035,986; and 1918, 14,981,907 lb., valued at $9,628,228.

Today is an opportune time to send a check for the Comfort Fund of the 27th Engineers.

Chrome Ore in Cuba

All the deposits of chrome ore in Cuba that have thus far attracted attention are within 25 miles, and most of them within 10 miles, of the north coast, according to a U. S. Geological Survey bulletin. There are about 12 groups of deposits, which display considerable diversity in quality, size, and accessibility. One of the most westerly deposits is in the eastern part of the Province of Havana, and two are in the Province of Matanzas. The next group toward the east is in the Province of Camaguey, a few miles northeast of the city of Camaguey. Other groups of deposits are in the Province of Oriente, one near Holguin and another south of Nipe Bay, and there are three groups in the mountains near the coast between Punta Gorda and Baracoa.

All the deposits examined are in serpentinized basic rocks. Fibrous spots resembling asbestos commonly occur in the serpentine near the orebodies. The deposits are lenticular and in the form of tabular masses ranging in thickness from 1 ft. to more than 50 ft. and reaching a maximum length of more than 200 ft., but they may include small masses of serpentinized peridotite. Thin veinlike streaks of ore have also been noted. The orebodies appear to be characteristic magmatic segregation deposits, and resemble many of those found in masses of serpentine in California and Oregon.

The ore is generally fine grained to medium coarse grained, and varies from spotted material consisting of black grains of chromite, ranging in diameter from a thirtieth to a quarter of an inch, embedded in white or light-green serpentine, to solid black material containing little or no visible serpentine. Fine seams of a green crystalline mineral, uvarovite, a calcium-chromium garnet, are occasionally found in the ore.

Most of the masses of ore are highly inclined, and certain of them that are exposed in ravines on steep hillsides in mountainous or hilly regions dip at about the same angle as the hillsides. The deposits west of Nipe Bay are in areas of moderate relief; those near Camaguey are in an area of low relief. The deposits in the eastern part of Oriente Province, which are the largest, are situated in a mountainous country and are difficult of access.

The reserves of marketable chrome ore in Cuba range from 92,500 long tons to 170,000 long tons, but only about 2000 tons of ore can probably be shipped in 1918 unless greater efforts to exploit it are made. The largest known deposits of chrome ore in Cuba—those of the Caledonia, Cayoguan group, and Potosi claims—are near the northeast coast of Oriente, in a region difficult of access. They may yield 72,500 to possibly 130,000 tons of ore, most of which can be brought to present commercial grade by simple concentration. With suitable transportation facilities and mining equipment, and with sufficient labor, most of this ore could be mined and shipped within two years after these conditions had been established. At the time of the examination only one deposit was ready for production, and on a small scale, but it seemed that the rate of production could be greatly increased by the employment of more miners and pack animals. It would require some time to put the other deposits in this region in condition for production.

The next largest known group of deposits is near Camaguey. They are easy of access, but are of lower grade than those in Oriente Province. They appear to contain 20,000 to 40,000 tons of ore, most of which can be gathered by hand from the surface. Near Matanzas, Cardenas, and Holguin there are small stocks of ore that are ready for shipment, perhaps 1000 tons in all. The ore near Holguin is of medium grade, but that near Matanzas and Cardenas is generally of lower grade. The expense of hauling the ore is reported to be almost prohibitive.

United Eastern Mining Co.

The first annual report of the United Eastern Mining Co., of Arizona, covering the operations for the year ended Dec. 31, 1917, contains information with regard to the results for the new mill and cyanide plant which was put into commission on Jan. 4 of that year.

The ore is high grade and the gold free milling. A negligible amount of refractory mineral is present, and amalgamation is not practiced. Milling in cyanide and all sliming is the system of treatment in use, and the rich gold solution is decanted from the ground ore, after agitation, by the continuous counter-current process.

During the year the rated capacity of 200 tons per day was increased to 270. Additions to the plant included one 40 x 12-ft. Dorr thickener, to reduce dissolved losses; one 30 x 8-ft. thickener of the same type, for the purpose of removing slime from the solution going to the clarifiers, and three 24-ft. diameter Dorr agitators. Theoretical calculations of performance failed to materialize, and, although the mill was designed with the expectation that 75% of the gold would be dissolved before the pulp reached the agitators, the actual amount was nearer 25%. The additional equipment effected an increase of 0.5% in the total extraction, and permitted the amount of ore handled to be raised by 30 tons, and two Dorr classifiers were installed to replace Callow screens and a bucket elevator.

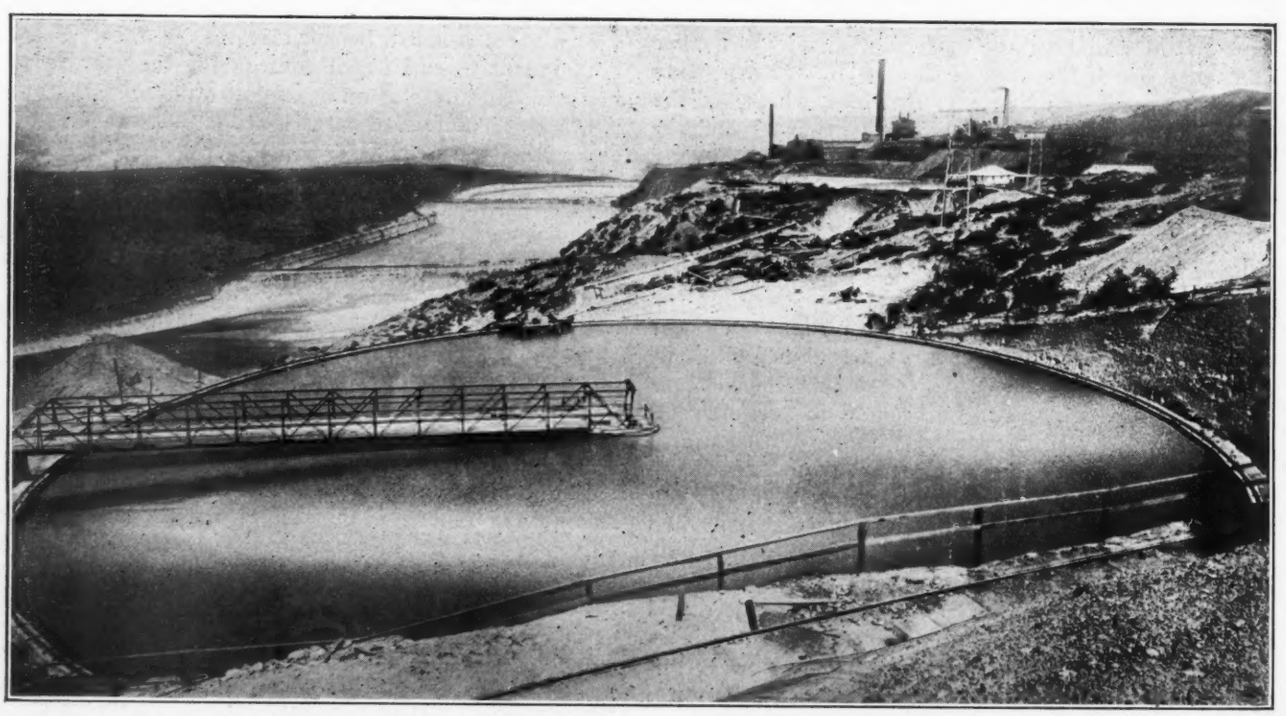
The plant treated 84,548 tons during the year, carrying gold and silver of an aggregate value of $22.42 per ton. The percentage of extraction for the year, based on assay results, was 96.41, with an average loss in residue of 80.6c. per ton. "Values recovered" are given as $21.617 per ton, but the phrase is misleading, as the figure includes $15,000 for "absorption in mill" and $553.17 for "slag on hand." Neither of these two items can be logically included under "recovery."

Operating costs, exclusive of depreciation and similar charges but including net administrative expense, amounted to $7.283 per ton, of which $4.181 is charged against mining and $2.159 against milling, and the ore reserves, as at Dec. 31, 1917, were estimated at 255,688 tons, with a gross value of $5,830,971.

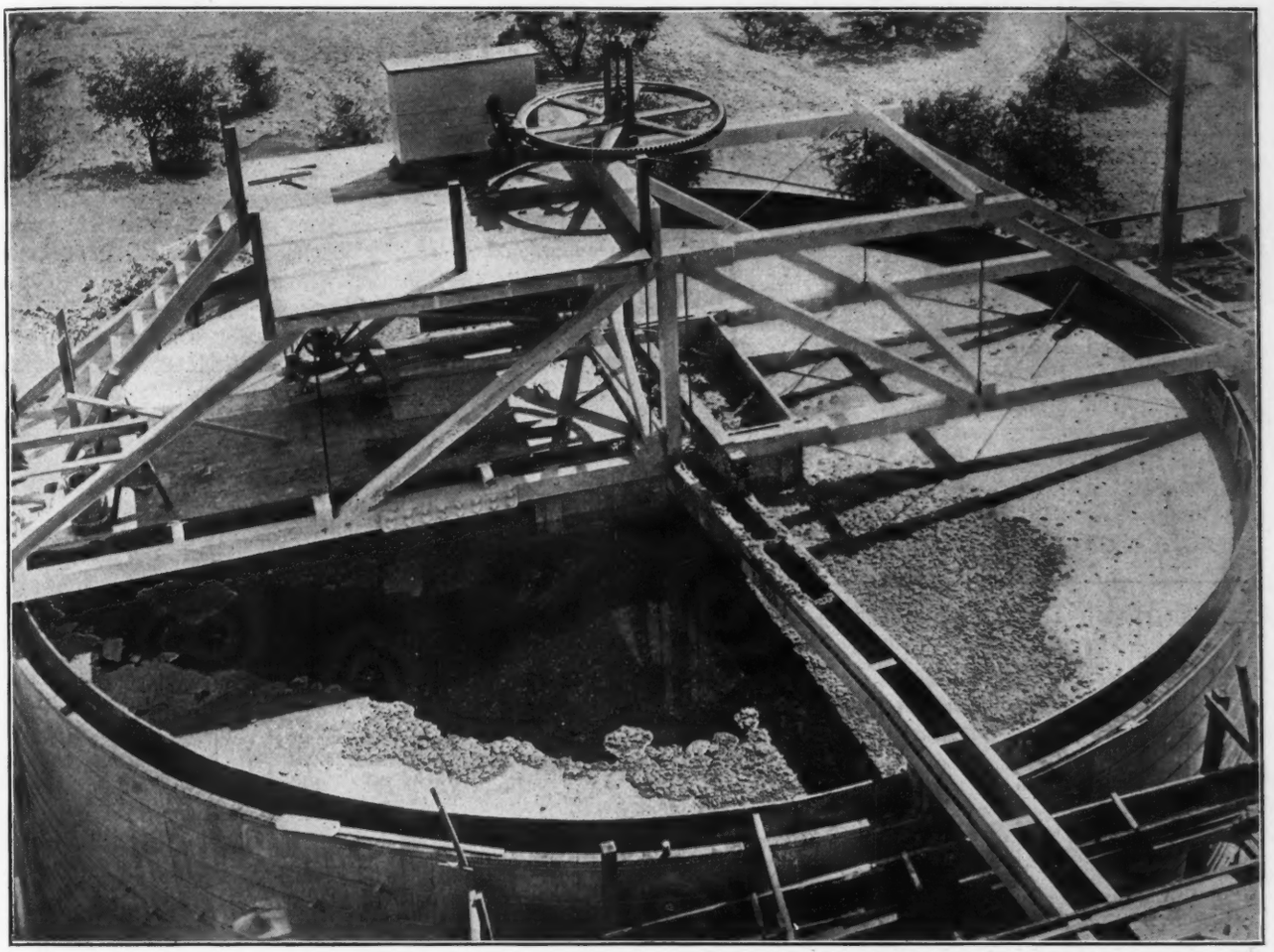
The general superintendent, J. A. Burgess, in concluding his report, acknowledges the coöperation and efforts of the staff, and mentions W. O. North, formerly mill superintendent and now assistant general superintendent; Wallace Keith, secretary and purchasing agent; J. W. Bradley, chief clerk; B. D. Boalen, mine foreman; Earl M. Bagley, mill foreman; L. E. Ward, master mechanic; B. C. Staiger, mining engineer; and D. G. Davies, geologist, in the order named.

Thickeners in Western Practice

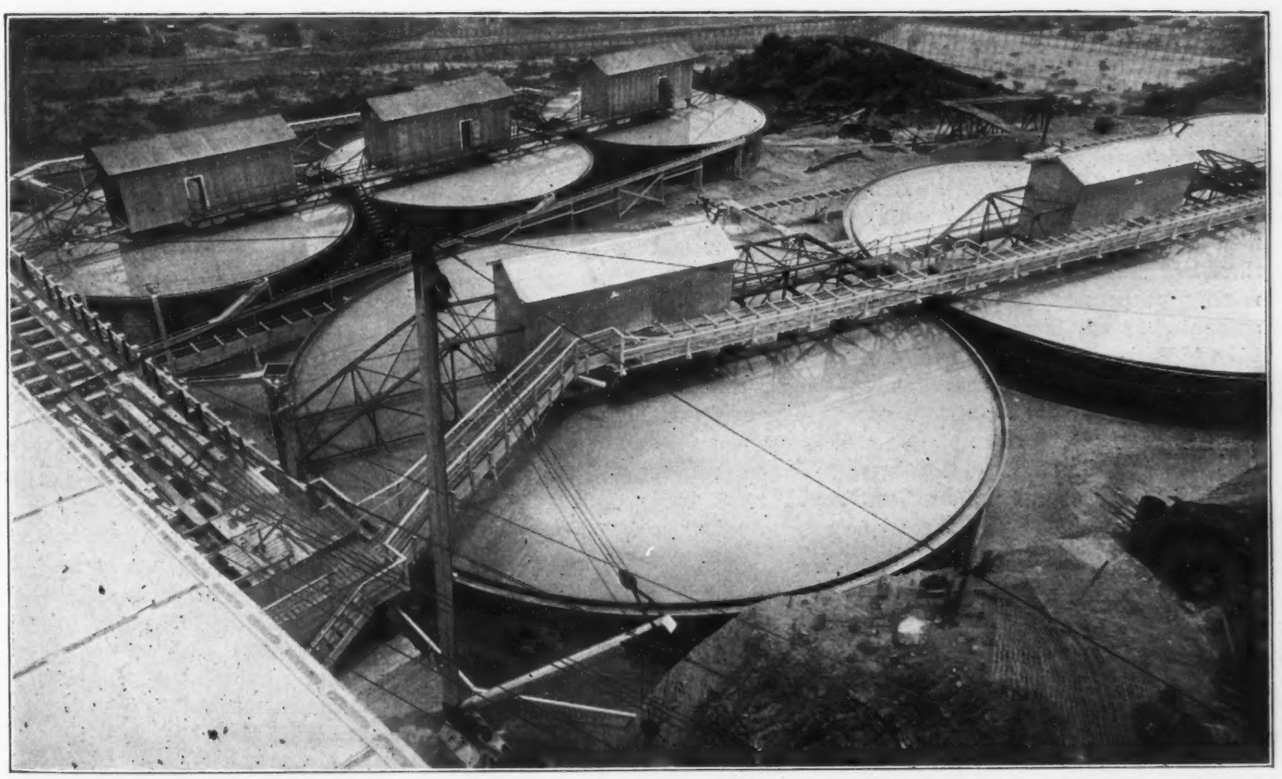
BUILDING WALLS OF 200-FT. DORR THICKENER OF INSPIRATION CONSOLIDATED COPPER CO., DEC. 31, 1916



THICKENER OF INSPIRATION CONSOLIDATED COPPER CO. IN OPERATION MAY 31, 1917, MIAMI, ARIZONA



THICKENER DEWATERING FLOTATION CONCENTRATES, BURRO MOUNTAIN COPPER CO., TYRONE, NEW MEXICO



THREE 100-FT. AND THREE 60-FT. DORR THICKENERS DEWATERING TAILINGS, INSPIRATION CONSOLIDATED

Sheet Zinc for Roofing

By W. H. SEAMON

Republication of an article originally printed in the "Engineering and Mining Journal" of Oct. 24, 1896. In the footnote of the original article Mr. Seamon says: "The information in this article has been derived mainly through the kindness of Mr. A. M. Layat, who has furnished the writer with all the European printed matter relating to the zinc industry. So thoroughly has this information been absorbed, that the writer is unable to properly accredit his several authorities, but has frankly disclaimed originality." For the purpose of the present publication a few immaterial paragraphs have been excised. The explanatory illustrations have been redrawn.

IN THE United States tin plate is the favorite metal roofing; the uses of sheet zinc for roofing are almost unknown; and yet in England, the home of the tin-plate industry, and in all parts of Europe, zinc is now the most favored material. It was first employed for roofing in 1811, when the Abbé Dony, the founder of the Belgian zinc industry, in his efforts to create a market for the consumption of his small output of spelter, roofed a house with sheet zinc. During the same year portions of the roof of the church of St. Barthelemy, at Liège, were covered with the metal, and both of these roofs exist today in good condition, although the first has always been subjected to the deleterious influences of the sulphurous fumes proceeding from the smelting furnaces of the Vieille Montagne Zinc Co. In 1820 the Théâtre de la Monnaie, at Brussels, was roofed with zinc, and up to the time of its destruction by fire in 1855, it is authoritatively stated that no repairs had been required. Mosselman, the successor to Dony, and the founder of the Vieille Montagne Zinc Co., continued the experiments of his predecessor with marked success, and without any special effort on the part of the company many buildings in Belgium, France and Germany were roofed with the metal, and during the year 1836 it is said that more than 12,000 tons of sheet zinc were used in France for roofing purposes, while the consumption in England amounted to only between 2000 and 3000 tons.[1]

In 1867 the smelting companies of Europe had careful examinations made of the then existing roofs, from which observations carefully prepared instructions for zinc workers were formulated and workmen were trained to handle the metal properly. Since then the increase in consumption has been rapid, until today more than 100,000 tons of sheet zinc are annually used for roofing purposes in Europe, and it is now recognized there as a durable and desirable roofing material, taking the place of lead and copper because of its greater economy. Its comparatively low cost has secured its application on structures of all kinds, palaces, municipal and state buildings, cathedrals, chapels, churches, schools, universities, hospitals, hotels, depots, theaters, warehouses, manufactories, stores and private dwellings. The German Imperial Palace, the University of Bonn, the Berlin Academy of Fine Arts, the Cathedral of St. Marys at Düsseldorf, the Hotel de Ville and Cathedral de Ste. Clotilde in Paris, the Haymarket Theater, Canterbury Cathedral and the government dockyards in England, are a few of the large structures covered with it in Europe; while, until very recently, a courthouse in Indiana and a high-school building in Missouri were the only instances of its employment in this country.

The family residence of Hon. L. Bradford Prince, formerly Governor of New Mexico, at Flushing, L. I., was about the year 1839 roofed with zinc, formed of strips about 2 ft. in width and 10 ft. in length, united laterally, as shown in Fig. 1. It gave perfect satisfaction until about 1885, when some small holes were found in the sheets, and it was replaced by tin plate, which proved very unsatisfactory from the beginning.

In Europe, the business of zinc roofing is conducted by the various zinc manufacturers, and partly by roofing companies. The sheets are usually corrugated and stamped at the rolling mills, which are ready to execute special orders, though some of the roofers cut and stamp their own sheets. The usual lengths of the sheets are 7 ft. or 8 ft., but even 10 ft. may be had by special order, and they are from 2 ft. 8 in. to 3 ft. in width. For roofing purposes the following thicknesses are recommended by the Vieille Montagne Zinc Co.:

					36 in. × 72 in.		36 in. × 84 in.		36 in. × 96 in.	
	Thickness,		Weight per Square Foot,		Weight of Sheets,		Weight of Sheets,		Weight of Sheets,	
Gage	In.	Mm.	Lb.	Oz.	Lb.	Oz.	Lb.	Oz.	Lb.	Oz.
13	0.029	0.740	1	...	19	½	22	3½	25	6½
14	0.032	0.820	1	2½	21	1½	24	9½	28	2
15	0.038	0.950	1	5½	24	7½	28	8½	32	10
16	0.043	1.080	1	8½	27	13½	32	7½	37	2
17	0.048	1.210	1	11½	31	2	36	5½	41	8½
18	0.053	1.340	1	14½	34	8	40	4½	46	½

The various clips and fastenings may be had direct from the zinc rollers; the only labor required to be done by the roofer is that of bending the lateral edges of the sheets, and the actual operations of laying them.

The tools required are those commonly employed by tin and copper smiths. It is better to use wood mallets rather than metal hammers, since they thin the metals less at the points of impact. The shanks, anvils, etc., are of the various forms required for shaping and are familiar to all metal workers, as are the patterns for cutting metals. As a general rule solder should not be used in working zinc, since the metal is always weakened somewhat, perhaps no more than any other metal, at the soldered junction, but there is no special difficulty in the operation of soldering, except that a little more care must be taken in wiping and smoothing the joints than with some other metals. The best solder is composed of two parts of pure tin to one of lead, but any of the common varieties may be used, and the soldering flux, known as "killed spirits," made by saturating commercial muriatic acid with strips of common zinc, is applied in the usual way, with a brush, or a stick of wood roughened at one end.

The nails used are made of zinc, but since they cannot be driven into hard wood, those made of galvanized or plain iron are sometimes employed.

[1] "Journal of Gas and Sanitary Engineering," 1893, p. 419.

Sheet zinc owes its value for roofing purposes to its durability, lightness and economy as compared with galvanized iron, tin plate, slates and tiles, lead and copper, usually employed in this country. The latter two metals, generally regarded as the best, owing to their great cost are seldom adopted, and, in fact, zinc is as durable and costs much less.

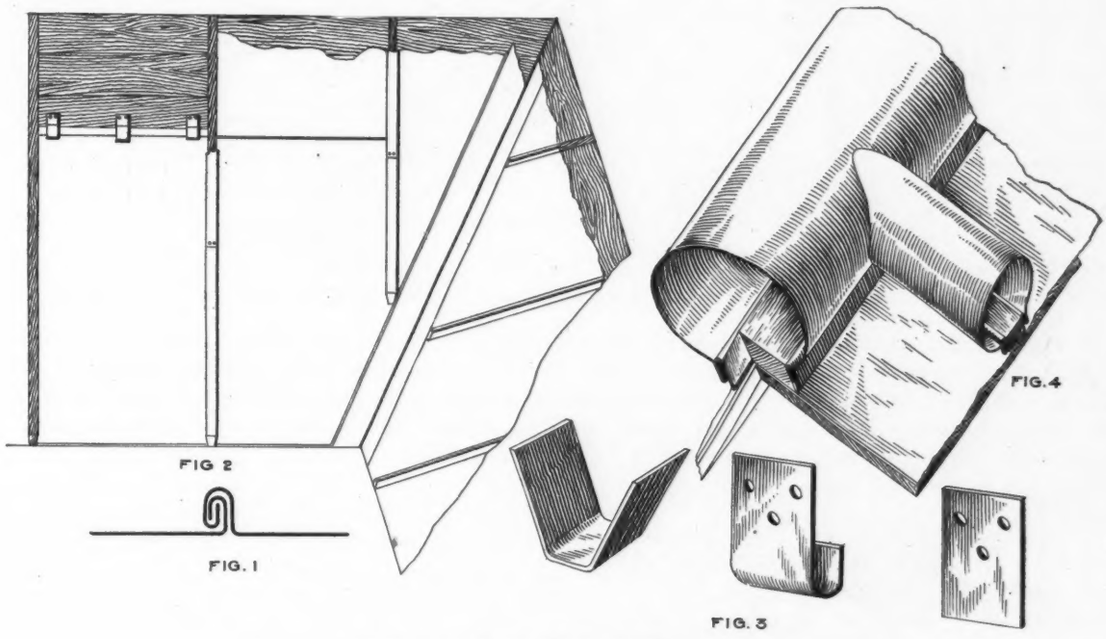
A good tin roof, properly laid, and painted thoroughly at least once in every three years, will last from 20 to 30 years (Trautwine). A well-laid slate roof will require occasional repairs in consequence of the loosening and cracking of the slates by frost and hail and the throwing of stones. On steep slopes the slates loosen more quickly, owing to their great weight constantly bearing on the nails, which gradually rust and loosen themselves. The life of a slate roof varies from 30 to 50 years. Galvanized iron is a very popular material for sheds, warehouses and factories, but it is not long-lived; the unequal expansion of zinc and iron gradually causes the zinc to scale off and expose the iron, and thus creates an electrical couple which results in the more rapid corrosion of the iron and destruction of the roof. This is delayed somewhat by frequent and thorough painting after the iron is exposed. With the greatest care 15 years is a long life for a roof of galvanized iron.

The superiority of sheet zinc over galvanized iron was shown in the case of the Northwestern Ry. station at Birmingham, England, which was roofed in 1853 with galvanized iron, and was carefully painted on both sides every three years and repairs made whenever required. Yet at the end of 13 years it was found to be rotten, necessitating its removal in 1867, when it was replaced with a zinc roof, which exists today in perfect order and has given but little trouble or expense for repairs.

The enamel-like coating of the hydrous carbonate formed on zinc roofs is practically insoluble to atmospheric waters and thoroughly coats every particle of the metal, absolutely preventing contact of the metal with the oxidizing atmospheric agents. A zinc roof of proper gage weighs from 125 to 180 lb. per 100 sq. ft.; lead about 800 lb.; copper the same; tiles, 1500 lb., and slate from 700 to 900 lb. The roof timbers when zinc is used need not, therefore, be so heavy or costly as for the other materials.

The different systems of zinc roofing are classified by the Vieille Montagne Zinc Co., according to the methods of laying and differences in the shape and the sizes of the sheets, as follows:

1. *Ordinary Roll Cap.*—This is recommended for slopes of not less than 20° and not more than 36°, and is always laid upon sheathing, usually with No. 13 zinc, in sheets from 6 to 8 ft. long (Fig. 2); the lateral edges of each sheet being turned up for 1 in., and held down to the sheathing and up to the battens by means of clips (No. 2, Fig. 3). One end of each sheet is folded under for 1 in. to 1½ in., while there is a corresponding upfold at the other end, and the upper edges of each sheet are held in position on the sheathing by a clip (No. 3, Fig. 3), which is soldered to the bottom of the sheet, and by two clips (No. 1, Fig. 3), which are nailed to the sheathing and engage with the folded edge of the sheet, so as to allow for a slight expansion. The form given to the roll cap which covers the battens, fitting over the upturned edges of the adjacent sheets, may be as shown in Fig. 3, which is a common form, or as in Fig. 4, which is much used in certain parts of Germany.



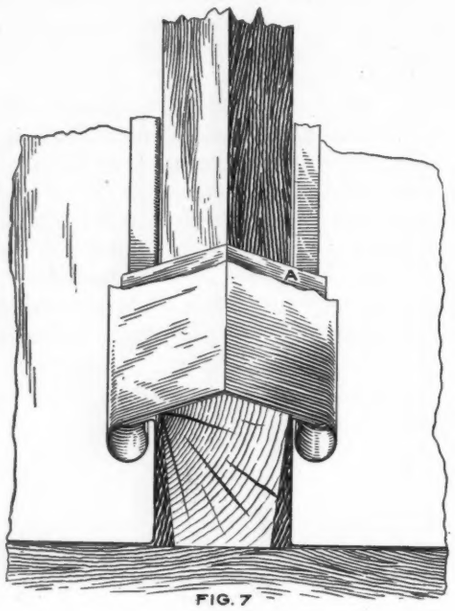
FIGS. 1 TO 4. ROLL CAP AND CLIPS

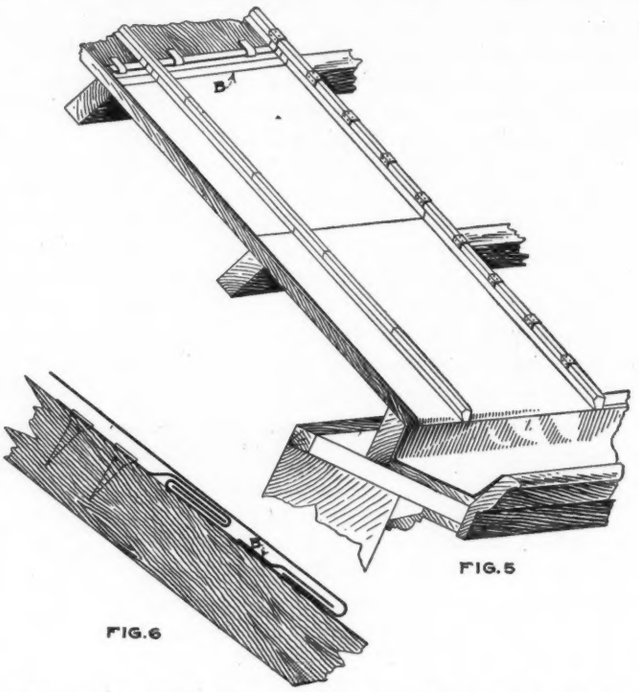
2. *Patent Roll Cap.*—The essential difference between this and the preceding lies in the manner of uniting the ends of the several sheets. A double fold (Figs. 5 and 6), prevents infiltrations by capillary action when laid on slopes as low as 4°. The form given to the battens and the manner of holding down the caps (Fig. 7), while essential to the claims of the patent, are not really necessary.

3. *Corrugated Sheets.*—The advantages of the corrugations lie in their ability to take up the lateral ex-

pansion and contraction in the sheets. No battens are employed, and the sheets may, or may not, be laid on sheathing, and on roofs framed of timber or iron. When used on sheathing, No. 13 zinc is sufficiently heavy; but when no sheathing is employed a heavier gage up to 18 number of No. 39 for iron framing (Fig. 10). When these are laid on sheathing, which seldom occurs, clips made of zinc similar to those employed upon the flat sheets are used.

The patent double-ribbed system is only another form





FIGS. 5 AND 6, DOUBLE FOLD. FIG. 7, FORM GIVEN TO BATTENS AND METHOD OF HOLDING DOWN CAPS

should be used (Fig. 8). Another style of corrugation, called the patent corrugated (Fig. 9), is claimed to possess all the advantages of the corrugations, and the same weight of zinc will cover a larger area, the width being 3 in. greater. When ordinary corrugated is laid of corrugation much used for dwellings, on which it may be applied with or without sheathing. It is held in position with nails and clips, as illustrated in Fig. 11.

4. *Tiles.*—These are laid on sheathing and are well adapted for roofs on all slopes above 10°. The sizes as

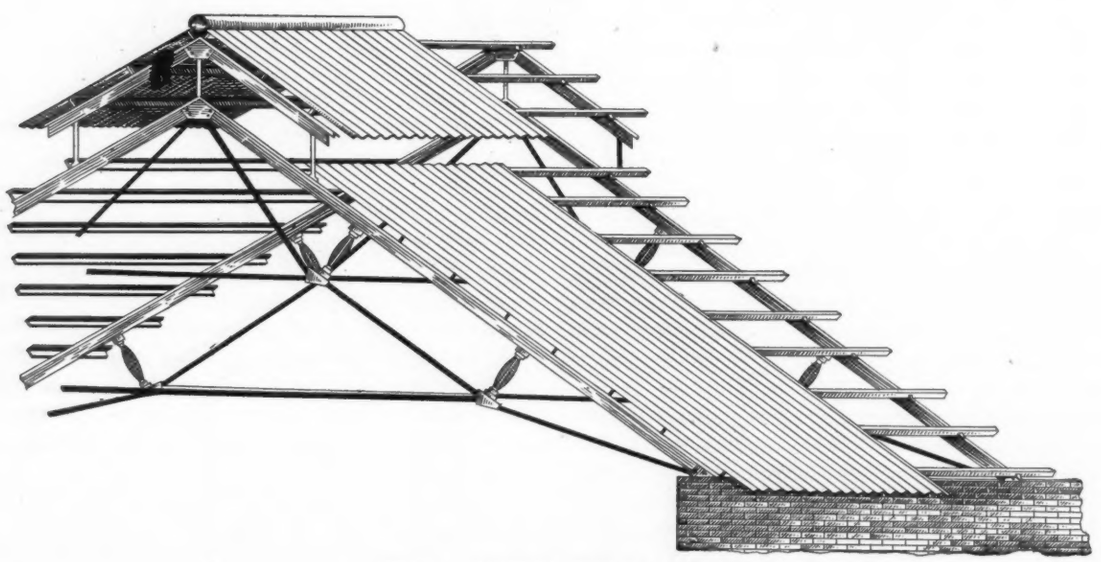


FIG. 8. CORRUGATED ROOFING

on iron framing, 6 or 12 clips, No. 26, are employed; if laid on wood framing 6 to 12 of No. 27, and as many of No. 29, are used. The clips are attached to the sheets by soldering, but for the "patent corrugated," 8 iron clips, No. 41, are used for wood framing, and an equal well as the shapes of the tiles are varied, and frequently are stamped with figures intended for ornamentation (Figs. 12, 13 and 14) and are very easily laid, and give, perhaps, the best results obtainable by the employment of zinc.

The first care of the zinc worker is to observe the carpenter work and have any defects corrected which would interfere with the proper laying of the roof. The sheathing, when employed, should fit snugly along the lines of union, and the upper surface should be made smooth. Particular care should be taken to remove all projecting sharp edges which might cut through the zinc. All nail heads must be countersunk. If no sheathing is employed and the sheets are laid on strips, these should be placed at regular intervals, parallel to the ridge pole. Defects in the carpenter's work

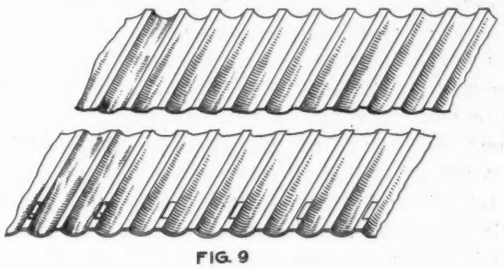


FIG. 9

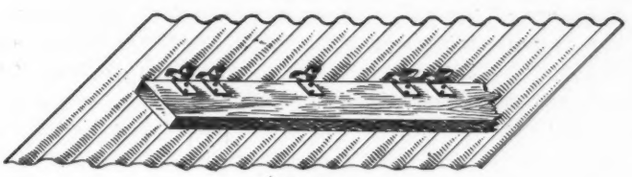


FIG. 10

FIG. 9. PATENT CORRUGATED ROOFING
FIG. 10. METHOD OF ATTACHING CORRUGATED SHEETING TO PURLINS

having been corrected, the next step is the laying of the gutters and the valleys.

Formation of Gutters.—The roof projections and the arrangements for the cornice control the construction of the gutters.

Eaves Projecting Over the Cornice.—This is the simplest mode of construction. The gutter is formed, in the shop, of proper shape and dimensions in sections, each about 7 ft. in length, attached to each other by double laps and carefully soldered. Shoulders at least 2 in. long are provided at the openings for the downfalls. The gutter is supported on brackets, attached to the walls at intervals of 6 ft., and straps should pass over it at each bracket to hold it in position. The gutter should not be firmly attached to more than one bracket, usually the central one, in order to allow it to expand and contract. The downfalls may be connected with the shoulders by angle joints, which are not soldered at either connection, or the shoulders may extend vertically into an enlargement of the upper part of the downfall, as shown in Fig. 11. If the first method is followed the gutter can freely expand and contract without endangering any of the fastenings of the downfalls.

Downfalls are made in lengths of 6 ft.; their vertical edges only are soldered. Strips of zinc are soldered to the upper ends of each section, and these nailed to the wall. No. 18 zinc should always be used for downfalls and gutters, since they are subject to greater corrosion and have no additional supports.

Trough of a Wooden Cornice Forming the Gutter.—Fig. 16 shows the arrangement when the roof slopes into the trough, forming its inner wall. The gutter sheet must extend up the slope so that the lapped edge *A* will be at least 1 in. higher than the upper edge of the cornice mold, to prevent the water, when the gutter is full, from getting between the sheathing and the zinc. The lap should amount to at least 1 in. The clips *B* are 4 in. wide and 4 in. long and are disposed at intervals of about 20 in. between centers. This plan must always be followed when the roof is to be covered with tiles. The outer edge of the gutter may be held down after several methods. In all instances, strips of heavy zinc, No. 18, are attached to the upper edge of the cornice mold by nails of zinc or iron; these strips are 10 in. long, and should be placed at intervals of 20 in. between centers. Their width varies with the plan of attachment of the gutter sheet. Fig. 17 shows a common method, in which the strips extend over the edge of the cornice for about $\frac{1}{2}$ in., then downward for nearly the same distance, and are finally attached to the outer face of the cornice mold by nails. The outer edge of the gutter sheet is rolled over the strips in such a way as to allow a play, for expansion and contraction, of about $\frac{1}{16}$ inch.

Fig. 18 shows the disposition when the upper edge of the eave is below the upper edge of the cornice mold, the roof slope not forming part of the trough. The gutter sheet must extend up the roof slope until the lapped edge *A* is above the outer upper edge of the cornice mold. The figure also shows another plan for

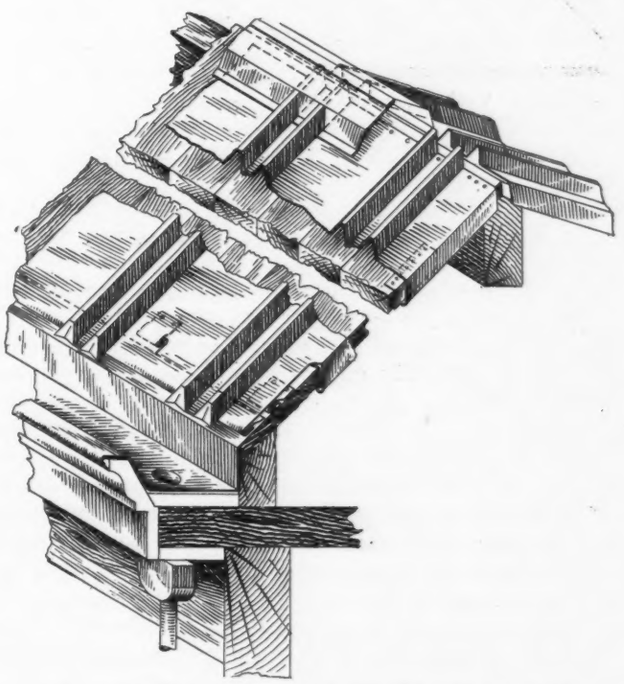


FIG. 11. PATENT DOUBLE-RIBBED SYSTEM OF CORRUGATED ROOFING

holding down the outer edge of the gutter sheet, in which the clips *C* extend for 1 in. beyond the edge of the cornice mold, over which the gutter sheet is rolled. This plan is common, but it is not so good as the former.

Figs. 19 and 23 show the arrangements when the eave is above the upper edge of the cornice. The inner edge of the gutter sheet is bent over, forming a projection of about $\frac{3}{4}$ in., sloping downward, over which the roof sheets are bent. The inner edge is held to the roof by clips *C*.

This arrangement allows wind to get beneath the roof sheets and blow them loose. When the sheathing extends about 1 in. beyond the inner vertical wall of the gutter, a firm attachment may be secured. The roof sheets are bent over the sheathing so as to engage with the gutter sheet and the lower face of the sheathing; a few nails may then be driven on the lower face of the sheathing to hold the sheets in place.

Figs. 20 and 21 show another and more secure form of holding down the outer edges of the gutter sheets. The clips *C* are bent down at right angles, leaving space for the gutter sheet to pass between them and the cornice mold. A small play is left for expansion and contraction.

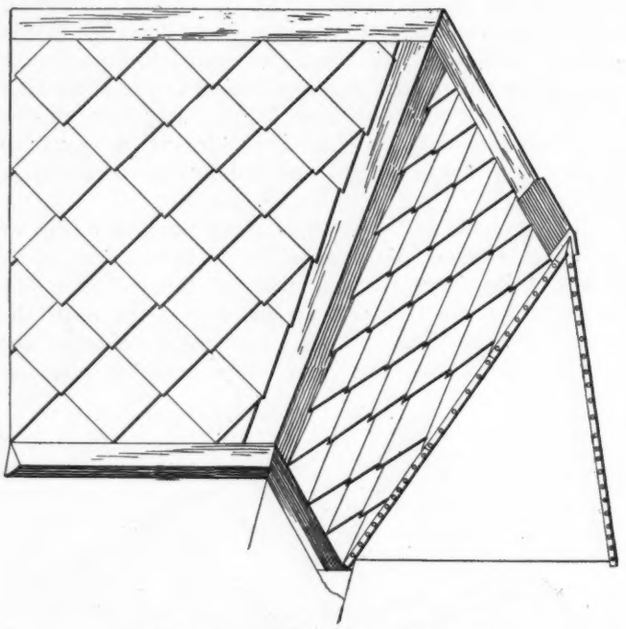


FIG. 12. METAL TILE ROOFING

Fig. 22 shows the disposition when no sheathing is employed. The gutter sheets are connected with each other by lap joints, well soldered. The ends are closed by a piece of zinc. The gutters should not be firmly fastened to the cornice trough, thus allowing some play for expansion. If there are reasons for fastening the gutter to the trough, expansion joints must be employed. Fig. 23 shows the arrangement when there is no objection to placing downfalls wherever they may be required; this divides the gutter into sections with one downfall for each section. A space of about 3 in. is left between the ends of the two gutter sheets. To the end of each sheet, vertical strips *C* are soldered, or the ends of the gutter sheets may be bent upward, but this is not recommended. The vertical sections rise to a point a trifle higher than the outer edge of the cornice, when their upper edges are bent over, as shown in the figure, and over these a clip *B* is fitted.

It is frequently impossible to have so many downfalls as this method requires; it then becomes necessary to employ the method shown in Figs. 24 and 25. A space of about 4 in. is left between the gutter sheets; strips *A* and *B* are soldered to the upper and lower sides of the adjacent ends, so as to form a groove, into which is inserted a sheet of caoutchouc, *C*, which is riveted in place, and which expands and contracts inversely with the gutter sheets. To protect the caoutchouc from the heat of the sun, a cover sheet, *D*, is provided, which is a strip of zinc, *D*, placed over the joint and held in place by clips *E*, which are soldered to the ends of the gutter sheets. This cover strip may be easily removed, allowing examination of the caoutchouc and its replacement when worn out. This plan is not equal to the former and is also more costly.

In all cases the sheets are soldered at the shop and carried to the building in suitable lengths for handling. It is important that the shoulder leading to the downfall should not tightly fit in the opening in the cornice, but should allow room for the expansion of the gutter.

Whenever possible the eaves should be above the upper edge of the cornice, projecting for 1 in. over the inner wall of the cornice. If this be done the roof sheets may be easily and firmly attached.

Construction of Valleys.—In the formation of valleys, the width of the sheet required will depend upon the amount of roof area drained by the valley. Several sheets may be soldered together, always with lap joints, so as to make sections from 12 to 15 ft. in length. If the slope of the valley be greater than 6 in. to the foot, the several sections may be united by single joints, as in Fig. 27. If the slope be less than 6 in. to the foot, the sections must be united by double lap joints, as shown in Fig. 28. The upper end of the valley sheet may be nailed to the sheathing, to hold it in place, while the lower end should likewise be as firmly attached as the construction will admit. The sides of the valley sheets are held in position by clips, placed at intervals of 20 in. between centers. The roof sheets may be attached by

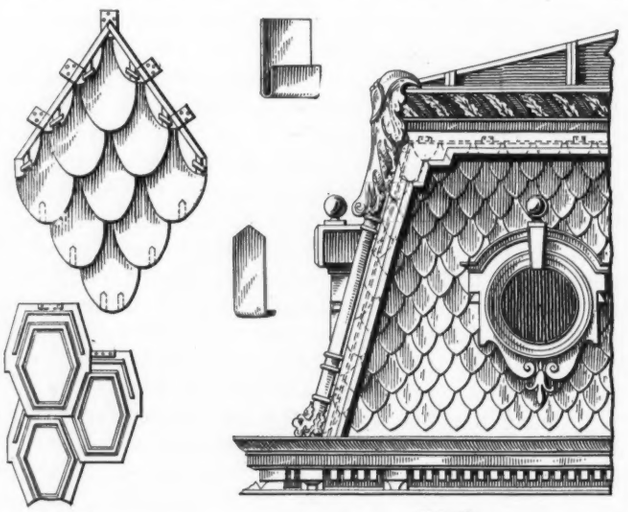


FIG. 14 FIG. 13

FIGS. 13, 14, 15. METAL TILE ROOFING

a single lap joint, as shown in Fig. 27, or by a double lap joint, as shown in Fig. 29. A common method of forming the double lap joints is shown in Fig. 29, and another method is illustrated by Fig. 26. In the latter no solder is required. The reason for using double joints in valleys and on roof slopes is that no water can then infiltrate by capillary attraction.

When no sheathing is employed in the formation of the roof, care is taken to break joints only at the rafters. When iron trusses are used, a sheet of iron is laid in the valley and riveted to the iron work; over this is laid the zinc for the valley, its lateral edges being folded over the edges of the iron sheet.

Flashings.—The flashings about chimneys and openings in the roof should not be formed until the roof approaches them, thus enabling the roofer to connect, to the best advantage, the flashings with the roof.

In forming the flashings about a chimney, the mortar is removed from the first course above the roof on the lower side of the chimney, from a depth of 1 in. to 1½ in. Into this groove a sheet of zinc of sufficient width and length is fitted; wooden plugs are driven to hold it temporarily in position. The sheet is extended down the face of the chimney, and it is made to conform to the angle of intersection of the chimney with the roof, by beating down with wooden blocks. If sheet zinc is used for covering the roof, the roofer will endeavor to have the last full sheet terminate within 2 ft. of the chimney, and not nearer than 6 in. The lower edge of the sheet *A* is made to engage with the roof sheets, with a lap joint like that used for connecting the roof sheets. At a distance of 1½ in. from the corners of the chimney the sheet *A* is cut vertically to the roof. A piece is also cut out of the corners, so as to allow the edge *B* of sheet *A* to be folded over, for the purpose of forming a lap joint with the following pieces of zinc. The free vertical portions of *A* are bent around the corners of the chimney, as shown in Fig. 31.

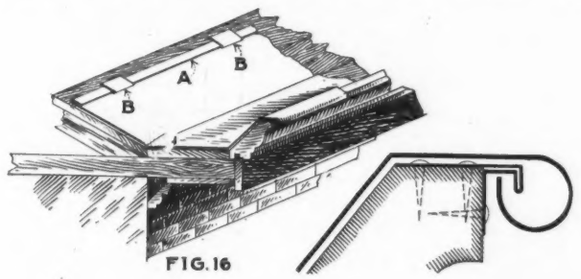


FIG. 16

FIG. 17

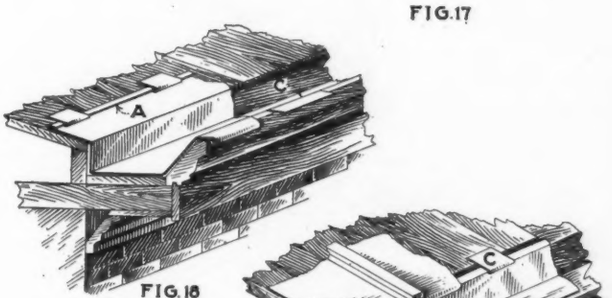


FIG. 18

FIG. 19

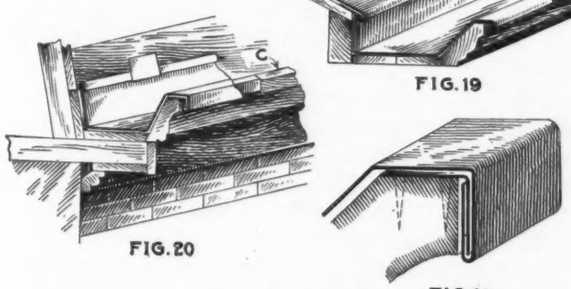


FIG. 20

FIG. 21

FIGS. 16 TO 21. ROOF TROUGHS, GUTTER AND CORNICE DETAILS

On the sides of the chimney, sheets *C* are taken of proper length and width; the edges *D* are bent down for 1 in., forming an engagement for the step flashings; the edges *E* are lapped under and engaged with the sheet *A*. On the upper corners of the chimney, the sheet *C* is bent around to the upper face for a distance of 1 in. to 1½ in., as the sheet *A* is bent around the lower corners. The edges *F* are bent over to form engagements with the succeeding sheet *H*. Step-flashings *G* are cut of proper shape and size, fitted into the grooves formed by removing the mortar from between courses of brick and engaged with the edge *D* of the sheet *C*. The mortar

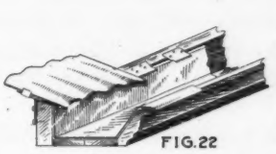


FIG. 22

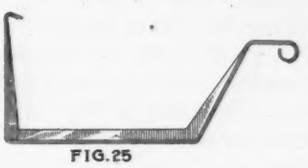


FIG. 25

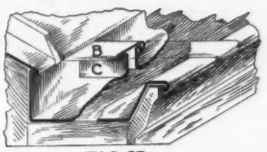


FIG. 23

FIG. 27

FIG. 28

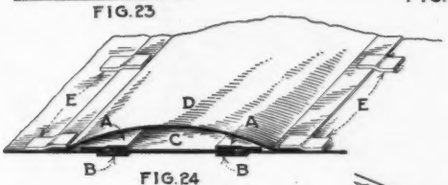


FIG. 24

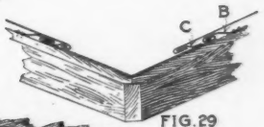


FIG. 29

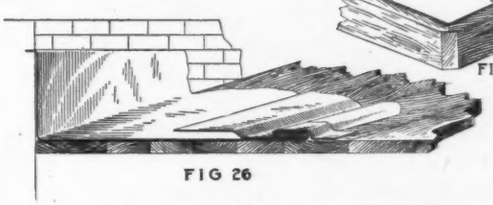


FIG 26

FIGS. 22 TO 29. ROOF DETAILS

is next removed from between the second and third, or third and fourth, courses of brick on the upper side of the chimney, into which the edge of a sheet *H* is fitted of proper dimensions. This sheet is made to conform to the roof slope, and at a distance of 1 or 2 in. from the vertical corners of the chimney it is cut so that it may extend around the corners for a short distance; it is also connected by a lap joint with the edge *F* of the sheet *C*. The sheet *H* is connected with the other sheets of the roof by the usual methods. The joints in the mortar are filled in with good cement.

When either of the "roll-cap" systems is employed, the battens must be stopped at a distance of 6 in. to 12 in. from the chimney. The exposed ends of the caps must be covered with zinc and soldered. It may be necessary to use a little solder about the angles of the chimney, but the workman should not be allowed to slur his work with the intention of using solder to cover up his deficiencies.

When corrugated sheets are employed, the general rules given above are applied, combined with those given later for laying corrugated sheets. More solder is required if the connections are to be water-tight. The same applies to the patent ribbed sheets.

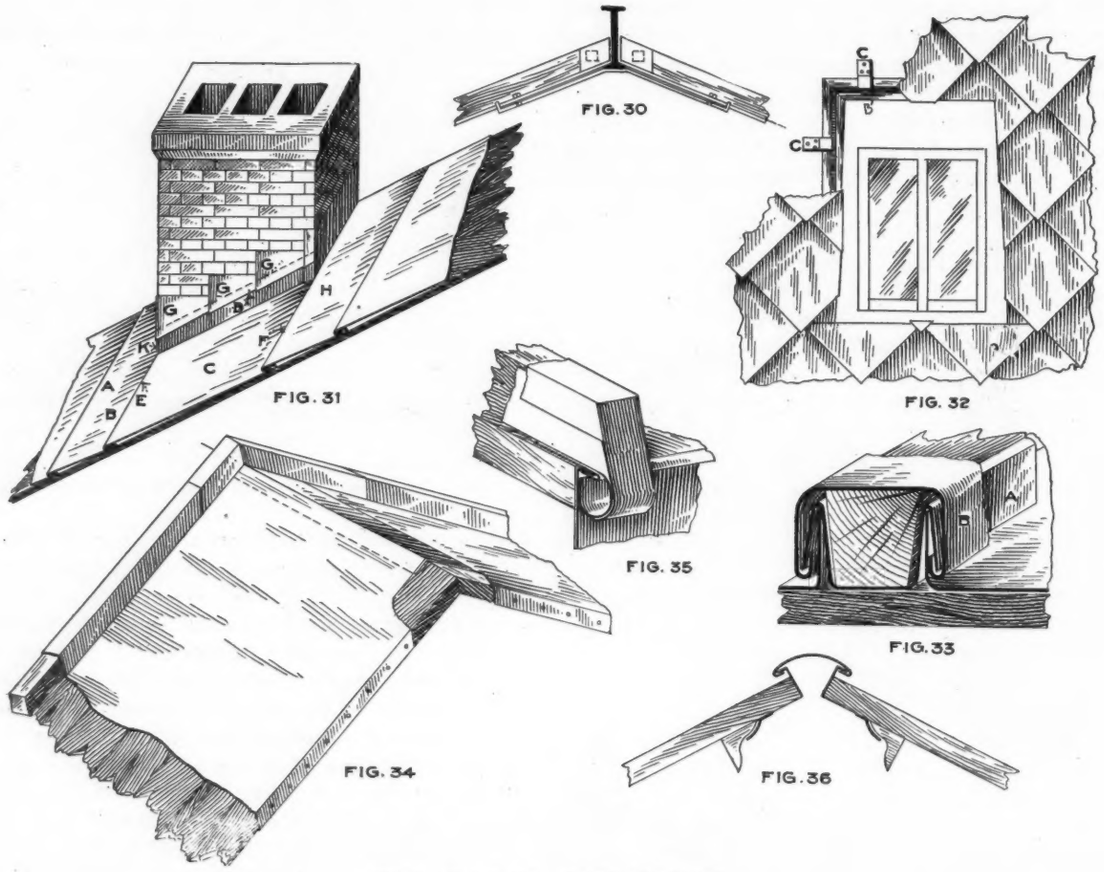
If a scuttle or skylight interrupts the continuity of the roof, the sheets are nailed to the inner edges of the woodwork around the opening, bent over the upper faces, down the sides, and then out on the sheathing, where they are connected with the roof sheets by the methods just described.

In the case of a tile roof, the openings, be they made by a chimney, scuttle or skylight, are surrounded with a sheet of zinc, made up of four sections united by solder; their outer edges, which should be within 6 in. of the opening, are turned over for 1 in., forming an engagement for the clips *C* which hold it to the sheathing. Immediately within these edges a 1-in. strip *B* of heavy zinc is soldered, extending all around the opening, on which the tiles are engaged; this is shown in Fig. 32. Particular attention is called to the manner of cutting and placing the tiles, for which the true method is shown in Fig. 32.

The gutters and the valleys having been laid, work on the roof is begun. If either of the cap systems are employed, battens must be used, laid at right angles to the ridge. If the roof is to be terminated by a ridge cap, this cap must be put in place. Similar arrangements must be employed for the hips, which are always finished after the plan adopted for the ridge. The placing of the battens depends on the width of the sheets. Usually the battens are made of well-seasoned pine 1¼ in. thick, of the same width at the top, and 1 in. wide at the base. In Fig. 33 the batten is shown with a flat surface, and in Fig. 7 with a bevelled top surface. The top may also be rounded.

The roofer must carefully study the best arrangement for the battens, and see that they are uniformly and properly laid, for they control all future operations in the several cap systems. If no ridge pole is used, the battens must exactly meet each other at the ridges of the several slopes, and be neatly joined. If a ridge piece is used, the battens are joined to it. It is important that no battens should be allowed to extend into the gutters or valleys.

In all cases the roofer begins laying the sheet at the lower end and outside edge of any slope. The arrangements made for the gutter control the methods of fastening the lower edges of the roof, and they have already been fully described. The outer edges of the sheets are engaged with clips, Fig. 11, made of No. 18 zinc in the manner shown. These clips are 12 in. in length with 1 in. projection, and width additional to allow for their firm attachment to the sheathing by nails. The other edge of the sheet is bent up for a height of 1 in., pulled up to the batten, and held securely in position by clips, No. 2, as shown in Fig. 3, of which there are three to the side of each sheet. These clips are best made of No. 16 zinc, and must be slipped under the battens at proper intervals, when the carpenter is laying the battens. They are 3 in. wide and long enough to pass under the batten, up their sides to the height of 1½ in., when they are bent downward for a distance of about ½ in., in all, usually, about 4½ in. long. To the bottom of each sheet, at its upper end, there is soldered near the center a clip, No. 3, Fig. 3, made of No. 16 zinc 3 in. wide and 5 in. long; one end is nailed to the sheathing and serves to hold the sheet at its original height on the slope. Two clips, No. 1, Fig. 3, are also used to hold down the upper edge, folding over the lap in the sheet, their free ends being nailed with three nails to the sheathing. These clips are made of No. 16 zinc and are 5 in. long and 3 in. wide. In a similar way the next



FIGS. 30 TO 36. ROOF DETAILS

sheet is placed in position, and the process repeated until the ridge is reached.

If a ridge piece is used, clips like No. 2, only longer, on account of the greater width of the ridge battens, must be placed before the battens are nailed to the sheathing. The ends of the sheets run up to the ridge piece and may be nailed to it, or held down with the clips. If no ridge piece is employed, the sheets extend over on each slope for a distance of 2 in., and are united by careful soldering. This disposition is shown in Fig. 34. It will be observed that the top and bottom sheets are always firmly fastened, while at the intervening joints there is always play enough for the changes due to contraction and expansion. The hips are finished precisely in the same way as the ridges, and the connections with valleys are made as with gutter sheets.

After the roof sheets are laid, the caps or rolls must be laid. These are strips of zinc, of sufficient width, intended to cover the battens, and close up the intervals between the sheets, so as to prevent the infiltration of water. The form of the cap may be varied. Fig. 33 shows one common form, and Fig. 4 shows one used in Germany. These strips are formed in lengths of 6 ft. They are laid, beginning at the bottom of the slopes, by engaging their inner upturned edges with the clips that hold down the sides of the sheets. The succeeding strip overlaps the preceding for a distance of 2 in. or 3 in. They may be united by lap joints, or, better, a nail may be driven into the upper end of each strip, which is covered by the lower end of the sheet following.

Fig. 7 shows another form of engagement, which properly belongs to the "patent roll cap" system. The clips *A*, made of No. 18 zinc, are 6 in. long, and about 3 in. wide; instead of being slipped under the battens, they are nailed to their upper faces, at intervals of about 20 in. between centers. It will be observed that with this system the edges of the sheets must be turned up against the sides of the battens till they reach the clips, and then bent downward, as shown in the figure. The cap engages with the edges of the sheets, as shown; consequently it must be made of No. 18 zinc to give the necessary strength to hold the sheets together. These caps fit over each other and are connected with double joints, as shown in Fig. 6.

If no ridge piece is employed, the caps run up to the ridge and are there soldered together, or a saddle, with 6-in. legs, is fitted over the caps.

If a ridge piece is employed, it must be covered with a cap, formed after the same pattern as the caps covering the battens, although it may frequently be enlarged into some striking effect of an ornamental character. Fig. 4 shows a form in which the ridge cap is given a circular cross section, about 6 in. or more in diameter. The caps covering the battens are always extended up to the ridge pole. The ridge piece is made in sections of about 6 ft., united by lap joints with each other, while the lateral edges are held down by clips, similar to those used in holding down the lateral edges of the batten caps. At the points where the latter intersect the ridge piece, openings are cut, and over them is soldered a piece of zinc, conforming to the form of the batten caps and extending beyond the ridge piece for about 6 in. The hips are finished off after the method for completing the ridge piece. The ends of the ridge pieces are closed by soldering on some ornamental finial, or by simply fitting a piece of zinc to the opening and soldering it to the ridge piece.

The preceding description applies principally to the ordinary roll cap. The "patent roll cap" is laid in a similar way, except in the manner of joining the sheets. With the ordinary roll cap, when laid on slopes of low pitch, water may infiltrate, by capillary attraction, through the joints. To avoid this a double lap is formed, as shown in Fig. 6. In Fig. 26, another method of forming a double joint, without the employment of solder, is shown. It is not, however, generally employed, although there can be no doubt of its superiority. Any form of cap or ridge piece may be employed for this style. It is well to increase the height of the battens when this system is used on long slopes of low pitch, to diminish the danger of water rising above the level of the edges of the sheets. With this system roofs of 4° slope may be covered. The lower ends of the batten caps are covered with pieces of zinc united with solder. In Fig. 35 is shown a popular method.

Corrugated Sheets.—Several styles of corrugations are shown in Figs. 8 and 9. The sheets are laid on sheathing, but generally their use is limited to covering sheds, warehouses, etc., in the construction of which no sheathing is employed.

Fig. 10 shows the method of fastening when used on wooden purlins. The lateral edges of the sheets overlap for one corrugation; along the outer edges, on the lower surfaces of the sheets, clips, No. 27, made of heavy zinc or iron, are soldered; through these, clips, No. 29, also of zinc or iron, are slipped and nailed to the upper slopes of the purlins. There should be three purlins to each sheet, and as each sheet is held by two clips to each purlin, no other fastenings are required. It would seem to be an improvement to nail the upper edge of each sheet directly to the purlins.

Figs. 8 and 36 show the method of attachment when iron purlins are employed. Four iron clips are soldered to the bottoms of each sheet, which engage with the purlins as shown. These methods of fastening are said to be satisfactory, even in localities where high winds are common. The sheets may be easily removed without injury and carried to other buildings. Fig. 36 shows the manner of forming the ridge, as well as the engagement of the retaining clips with the purlins. A strip of heavy zinc is soldered at intervals of 10 in. to the ends of the sheets. Over the strip is turned, in sections of 6 ft., a ridge piece of heavy zinc. The several sections overlap for several inches, forming a sufficient protection.

Tiles.—These may be square, hexagonal or diamond shaped and stamped with ribs, scales or any other ornamental figures. When used on dwelling houses they are made usually 10½ in., 13½ in. and 17 in. square and of No. 13 zinc; when used on large roofs they are made 23½ in. and 29 in. square, and are then made of No. 15 zinc. Tiles may be laid on any roof having a slope of at least 45°. They are particularly valuable when used on Mansard roofs. Fig. 13 shows some of the possibilities for ornamentation. Tiles are very easily laid by any metal worker, and are always laid on sheathing, which need not be perfectly smoothed.

The attention of the roofer must first be directed to the work in the gutters, valleys, flashings about chimneys, and other openings. If the gutter sheet extends up on the roof slope, care must be taken to have the

lapped edge made precisely parallel to the ridge pole, the upper edge of the strip being lapped over to form engagements for the tiles, and held down by clips. Its width need not be over 3 in., but it must sometimes be made wider at points, when the eaves are not parallel to the ridge. The cornice generally conceals such irregularities as would be very marked near the ridge, if not corrected. If the eaves are above the gutter and are parallel to the ridge, the strip of sheet zinc may be dispensed with, and the lower edges of the tiles bent over the sheathing and nailed to it. The first tiles laid must be half tiles.

They are held in position by turning under their lower edges and engaging them with a strip or by using clips. These clips are firmly nailed to the sheathing. Lines are now drawn on the roof to serve as guides to the roofer. The succeeding tiles are engaged, by means of their under-folded lower edges, with the upper-folded edges of the previous sheets; the clips are attached and nailed. The roofer stops his work at some convenient point within about 12 in. of the ridge, so that he may finish with half tiles. The ridge piece is formed of sheet zinc, the under turned edges engaging with the upper turned edges of the tiles.

Of the various forms of corrugated zinc, only one, technically known as the "doubled-ribbed" system, is laid upon sheathing. By reference to Fig. 11 it will be seen that this system is characterized by a system of double ribs, the ribs being about 1 in. in height and 1 in. apart. The distance between the pairs is about 6 in. The sheets are usually made about 3 ft. square, so that the ribs on each side will come within about 1 in. of the edges. Sheathing need not necessarily be employed, the sheets being laid upon strips, which must be placed at the junctions of the sheets. The position of the strips is regulated by the length of the sheets and the overlap that is to be given, which varies from 2 in. on steep slopes to 6 in. on moderate slopes. The corrugations take up all of the lateral expansion and contraction.

The method of laying this roof is shown in Fig. 11. At the eaves the sheets may be bent over the sheathing and fastened at the lower face of it, or the plan shown in the figure may be followed. Either plan gives satisfactory results. The sheets resting along the end cornices are turned over and nailed, or engaged with clips, as shown. The upper ends of each sheet are firmly nailed to the sheathing, and the following sheet covers the nail heads. The lower end of the following sheet has soldered, on two of the lower faces of the ribs, spurs of stiff zinc about 3 in. long, which slip under the ribs of the preceding sheet, holding it down.

The sides of the sheets engage with each other by side clips, alternately soldered to the upper and lower faces of the outside ribs. These clips are always attached at the factories where this form of roofing is prepared. Where the roofer is called upon to finish his work against brick partition walls, the details are in general similar to those followed in the formation of flashings.

When the sheet systems are employed, the sheets next to the partition wall are bent up for a height of 2 in. to 3 in. against the wall, and are held down to the sheathing by clips, which are made long enough to catch the upturned edges. After the roof is completed, step-flashings are constructed of sheets of zinc 3 ft. in length. They overlap at their joints for 3 in., and their free edges are made to extend over the roof sheets for a distance of 2 in. and are held down by soldering at the end corners and in the center, making a water-tight joint. Fig. 26 illustrates another method of forming the flashings without the use of solder. Where brick walls abut at the upper or lower end, the methods used are similar to the flashing already described.

Gutter sheets must always be soldered at their intersections, and expansion joints must be made at intervals of 25 ft., after either of the methods shown in Figs. 23 and 24, according to the nature of the arrangements of the downfalls. These directions will apply to all forms of sheets used. If the roof is covered with tiles, sheet zinc must be used to make the flashings, their lower edges terminating in a double joint to which the tiles are attached, as described under tile roofs.

Through the kindness of the Vieille Montagne Zinc Co., we are able to give the average surfaces which an experienced zinc worker with a helper can easily lay in one day of 10 hours:

	Sq.Ft.		Sq.Ft
Ordinary roll cap system:		Square shaped—11x11 in....	130
Sheets 1.81 m. in length.....	170	Square shaped—13¾x13¾ in..	150
Sheets 1 m. in length.....	190	Square shaped—17x17 in.....	180
Patent roll cap system:		Square shaped—23¼x23¼ in..	190
Sheets 0.81 m. in length.....	170	Double ribbed system.....	190
Sheets 1 m. in length.....	190	Fish scales.....	100
Corrugated.....	210	Flat roof—sheets divided from	
Patent corrugated.....	190	each other by sunken gutters..	170
Zinc tiles:		Wall facing, imitationof bricks..	140
Diamond shaped.....	110	Wall facing, imitation of stones..	170

The above represents average work on medium-sized surfaces, with the average number of chimneys and other interruptions of the roof's continuity. On large roofs, the average can be easily increased to nearly double the above; while on roofs with more than the average number of interruptions the above average will be decreased.

The table on page 629 shows the amonnts of material required, and the cost of materials and laying in Europe and New York. The prices given for Europe are the regular list contract prices of the roofing companies for which contracts can be made today, when spelter is selling in London for $3.63 and sheet zinc for $4.03 per hundred pounds. The New York prices are based upon the selling prices for Nov. 1, 1895, when spelter sold in that city for $3.90 per hundred and sheet zinc for $5.75; spelter now sells for about $3. In estimating the cost of laying zinc roofing in New York, the European prices for the same work have been taken and increased 50% to allow for the difference of the prices of labor in the two countries. It will be observed that the rollers of sheet zinc market their product in this country at an advance of $1.85 per hundred pounds, while the European rollers are willing to accept an advance of but 40c. per hundred. In comparing the cost of zinc roofing with other materials it is believed that fairness to the metal demands an estimate based upon prices near what they should be; we have therefore added a final column for an estimate, based upon an advance of 50% only in labor and rolling, including profits, which we believe can be accomplished in this country.

Examination of the following tables shows that the cost of a zinc roof in Europe is about the cost of a tinplate roof in the United States. The real economy of the

zinc roof cannot, however, be clearly seen without comparing the various materials with reference to cost of repairs and durability, as well as first cost. The following table contains estimates, which have been carefully prepared after due consultation with parties familiar with the subject, and while we do not claim that they are absolutely accurate for all parts of the United States, they are nearly so:

	Zinc	Tin	Slate	Gal. Iron	Tiles	Lead	Copper
Cost per square, including cost of laying	$11.75	$8.85	$10.50	$5.75	$12.50	$21.00	$30.00
Repairs in 30 years	1.15	11.25	3.50	11.50	2.50	.....	.....
Interest, 6%, on cost, 30 years	21.15	16.75	19.90	11.35	22.50	37.80	54.00
Interest, 6%, repairs, 15 years	1.00	10.12	3.15	10.35	2.25	.....	.....
Total	$35.05	$46.87	$37.05	$38.95	$39.75	$58.80	$84.00

In the item for repairs for the tin roof we have assumed it would last for 30 years, provided it was painted every two years at a cost of 75c. a square. In some localities it need be painted only every three years. We have not, however, allowed for the soldering of the tin roof, usually necessary, from time to time; this constitutes all of the repairs on zinc roofs. The differences are more marked than the figures indicate, for, at the expiration of 30 years, the tin roof, as well as that made of galvanized iron, must be renewed; the slate roof may or may not be good for another 30 years, but the zinc roof will be good for 50 more at least. Slate and tile roofs require heavier framings, and this is not included in the estimates.

Zinc, when used for roofing, is exposed only to the chemical effects of the ordinary atmospheric constituents. Zinc decomposes pure water with the formation of zinc hydrate and the evolution of hydrogen gas. The reaction is not, however, continuous, as the zinc speedily becomes coated with a protecting envelope of insoluble hydrate, destroying the contact of the metal and water, when further action must cease. Unlike some of the other useful metals, the oxygen of the hydrate does not transfer itself, or penetrate to the underlying metal, so that, with the exception of the alteration of this thin pellicle, zinc may be preserved indefinitely in pure water. If chips of zinc are placed in contact with copper turnings in water, the zinc is rapidly attacked, hydrogen being evolved. If the water contains impurities, such as saline substances, the zinc is more rapidly attacked, since the hydrate is soluble in such, or acid solutions.

Moist air, deprived of carbonic acid, attacks zinc, but very slightly unless some less oxidizable metal is placed in contact with it, whereby a galvanic couple, with the zinc as the negative pole, is formed. Moist air containing carbonic acid forms a grayish coating of the hydrous carbonate of zinc, which adheres with great tenacity to the metal and becomes harder than the metal itself. It cannot be removed without employing a steel scraper, or moderately strong acid solvents. This coating forms a natural paint or varnish for the zinc, completely protects the underlying metal from further oxidation and constitutes one of the most valuable features of zinc roofs, since no artificial paint is required. If it were not for the small amounts of acid present in atmospheric waters and the abrasion due to their fall and flow over the sheets, the roof would be everlasting. The wearing away due to these causes is slight, as shown by experience and careful observations and experiments. Pettenkoffer examined a roof at Munich, and found that during 27 years' exposure, 8.38 g. of zinc had been oxidized on each square foot (Bavarian) of surface, of which about one-half had been carried away. The zinc had been penetrated for a distance of 0.0005 of a meter.

COST OF ZINC ROOFING

Style of Roofing	Size of Sheets	Number of Clips per Sheet	Gage of Zinc	Weight per 100 Sq.Ft. Including Clips, Lb.	Cost of Materials in Europe	Contract Prices for Materials and Laying in Europe	Present Cost of Materials in New York	Estimated Cost of Laying in New York, Including Cost of Materials	Estimate of Total Cost of Materials and Laying in New York by Development of Industry
Ordinary roll cap	36 in. × 96 in.	No. 1, 2 No. 2, 6 No. 3, 1	No. 13 No. 14	133 115.5	$5.36 6.26	$8.37 9.26	$7.65 8.37	$12.15 12.87	$10.48 11.05
Patent roll cap	36 in. × 96 in.	No. 1, 2 No. 13, 5 No. 3, 1	No. 13 No. 14	138 151	5.56 6.08	8.57 9.08	7.93 8.68	12.43 13.18	10.71 11.29
Patent double ribbed	39¾ in. × 51½ in. Distance between each pair of ribs, 13 in. Number of sheets per square, 7.44	7	No. 13 No. 14	140.5 155.5	5.66 6.27	9.30 9.91	8.11 8.86	13.57 14.32	10.82 11.50
Tiles, square	13¾ in. × 13¾ in. 23½ in. × 23½ in.	No. 10, 1 No. 11, 2	No. 13	185.5	8.28	10.45	10.66	14.06	12.21
Tiles, hexagonal	10½ in. × 16 in.		No. 13	150	6.65	9.50	8.62	12.89	11.39
Tiles, fish-scale	24¾ in. ×	No. 30, 6 No. 4, 4	No. 13	188	8.33	10.65	10.81	14.29	12.19
Ordinary corrugated	29½ in. × 83½ in.	Iron framing No. 26, 6 Wood framing No. 27, 6 Wood framing No. 29, 6	No. 13 No. 15 No. 15	151 171 175	8.14 7.23 7.40	12.20 9.84 10.10	12.22 10.34 10.58	18.39 14.25 16.13	15.61 11.02 13.00

From this observation, we find that a roof made of No. 13 zinc would require 400 years for complete oxidation, and that one made of No. 18 zinc would require 723 years.

The chief solvents existing in the atmospheric waters are carbonic and sulphurous acids. To determine their effects, we exposed, for 100 days, 10 pieces of sheet zinc, each 1 ft. square, to the action of 5 l. of water, containing 0.5 g. of sulphurous acid and an equal quantity of carbonic acid to the liter. Previous to immersion the plates were coated with the hydrous carbonate by exposing them for some time to the action of the atmosphere. Nearly every day the vessel containing the plates was gently shaken, care being taken to prevent them from rubbing against each other. At the expiration of the period, the amount of zinc dissolved was accurately determined, after the usual methods, and was found to equal 0.2266 g., corresponding to a removal in one year of 0.00000244 m., from which we estimate that No. 13 zinc would require 303 years, and No. 18 zinc 548 years for complete solution in atmospheric waters, containing such large amounts of acids. It is, perhaps, needless to say there are no records of atmospheric waters containing so high a proportion as that named above.

WHITE HOUSE
WASHINGTON

Again the Government comes to the people of the country with the request that they lend their money, and lend it upon a more liberal scale than ever before, in order that the great war for the rights of America and the liberation of the world may be prosecuted with ever increasing vigor to a victorious conclusion. And it makes the appeal with the greatest confidence because it knows that every day it is becoming clearer and clearer to thinking men throughout the nation that the winning of the war is an essential investment. The money that is held back now will be of little use or value if the war is not won and the selfish masters of Germany are permitted to dictate what America may and may not do. Men in America, besides, have from the first given now dedicated both their lives and their fortunes to the vindication and maintenance of the great principles and objects for which our Government was set up. They will not fail now to show the world for what their wealth was intended

Woodrow Wilson

National Exposition of Chemical Industries

TO AN ENGINEER, a compact technical exhibit has a distinct value in broadening his outlook and giving him an accurate conception of the relation of his own work to that of the industry as a whole. It is in the nature of a coördinating and balancing force that is perhaps not appreciated to the degree that it should be. In both a technical and popular sense, the National Exposition of Chemical Resources, held in New York, at the Grand Central Palace, in the week beginning Sept. 23, was a marked success.

The dominant feature of the exposition was the attention paid to those notable expansions in industrial and technical effort which have directly resulted from the impulse of the war; and the significant bull's-eye mark, indicating that the material or apparatus in question had been produced since the war began, was seen on all sides. No better advertisement was necessary as an illustration of the enormous strides made in the chemical and allied industries in the United States.

All three floors were completely filled with exhibits, which showed a praiseworthy achievement on the part of the managers and promoters of the exposition in attracting and securing the coöperation of so large a number of exhibitors. The varied character of the products shown was a notable feature, and the general arrangement was admirable.

The progress made in the dyeing industry is perhaps of indirect interest to the mining fraternity, but the visiting engineer could hardly have left the building without the conviction that it was in this industry that the most notable advances had been made; that intricate problems had been attacked with an ingenuity and perseverance that was in itself an inspiration. The exhibits from manufacturers of ceramics, laboratory glassware, porcelain and refractory materials were representative of an industry that is rapidly making the United States, in these respects, independent of all other countries.

Acid-resisting materials such as chemical stoneware, Duriron, SidiO, Bario, hard lead, hard rubber and wood were exhibited in their different manufactured forms. An excellent insight into this important branch was obtainable.

In mining and metallurgical equipment, operating models of ball mills, flotation machines, classifiers and thickeners, pressure and vacuum filters, driers, electrostatic separators, and concentrators were interesting features about which crowds of spectators gathered.

An educational exhibit of the variety of uses to which zinc might be put was made by the New Jersey Zinc Co. This, as well as the exhibit of the Anaconda Copper Mining Co. illustrated the progress which the larger mining companies are making in the utilization of by-products and the broadening of their market.

The exhibit of the E. I. du Pont de Nemours Co. was the most varied, ranging from artificial leather for automobiles to toilet articles. It is illuminating to find a company such as this, whose best-known products go to the mine and the battlefield, engaged in miscellaneous chemical manufacturing. The Hercules Powder Co. also showed its versatility by exhibiting an array of products, the names of which, with the exception of potash, are foreign to mining and metallurgical textbooks.

Electric furnaces, powdered-coal burning equipment, byproduct coke ovens and a straw gas generator indicated the varied lines of progress that the necessity for economical utilization of fuel is forcing upon our attention.

Not alone were the exhibits of interest, but the many valuable papers that were read and the illustrated descriptions presented helped round out the visitor's acquaintance with advances in chemical technology.

The session on Friday afternoon was a symposium on the metal industries. H. C. Parmelee, managing editor of *Chemical and Metallurgical Engineering*, was chairman of the meeting. Mr. Parmelee, in commenting upon the United States from the standpoint of metal production, said:

> The national advantage of holding premier rank among the world's metal-producing countries has been accentuated by the war. Among precious metals, 60% of the world's production of gold is controlled by Great Britain, mainly in South Africa and Australia. This, together with the further fact that less than 1% of the world's gold comes from European countries, has undoubtedly had a great economic effect in the conduct of the world's business during the war.
>
> The United States holds second rank in the production of gold, but first in silver, producing about 30% of the world's total. Under normal conditions Mexico would be a close second, with Canada, Australia, and Germany following. Russia is unquestionably the leader in platinum, and Colombia next.
>
> In pig iron and steel, the United States easily holds first rank, with an average production in recent years of about 40% of the total. Germany follows, with about 25%. The United Kingdom is third, and France and Russia divide fourth place.

The paper by Alcan Hirsch, of the Hirsch Laboratories, on "Ferrocerium Pyrophoric Alloys," was particularly interesting in that it described how the demands of the war had caused the development of a new industry in the United States. Mr. Hirsch described the preparation of the electrolyte and the electrolyzing of the molten cerium salts, as well as the manufacture of the well-known cerium-iron alloys.

Theodore Swann, of the Southern Manganese Corporation, presented an important paper on the ferromanganese industry and its development within the United States. He stated that in 1914 the United States produced less than 1% of its ferromanganese requirement, but that over 90% would be produced from domestic supplies in 1918; that though the average recovery of manganese from its ores was 73%, there were possibilities of increasing this recovery by careful investigation of the process of reduction. The importance of the electric furnace as a method of manufacturing ferromanganese was indicated. Professor Joseph W. Richards, of Lehigh University, gave an excellent summary of data concerning the ferroalloys, commenting on the ferroalloys of silicon, tungsten, uranium, vanadium, molybdenum and titanium.

An unusual and especially valuable feature of the exposition was the daily journal published by *Chemical and Metallurgical Engineering*. The more important papers were given in full, as well as summaries of progress made in different lines of chemical industry. Illustrations of the exhibits, a directory of exhibitors, and editorial comment made the publication a useful record of events to the visitors and a valuable reference for the engineer who might desire to review at leisure the somewhat crowded happenings of the week.

Events and Economics of the War

The end of the war was brought visibly nearer, when Bulgaria dropped out of the struggle on Sept. 30, after her plea for an armistice had been accepted by the Allies; her lines had been shattered during the week and her territory invaded. Operations by the Allies against other belligerents in the Balkans continue. The Austrians are withdrawing in Albania and the Germans in Rumania, it is reported. The British advance continues in Palestine, 50,000 Turks and 325 guns having thus far been taken by General Allenby. On the Western front, the greatest battle of the war is raging from the sea to the Meuse, and the Hindenburg line is rapidly crumbling under the Allied pressure; simultaneous attacks by the Americans east of Argonne forest and by the French to the west overcame the enemy's main defenses, and, continuing, threaten his communications; the French dominate the Chemin des Dames ridge, the British have entered Cambrai, which is in flames, and the Belgians have advanced to within two miles of Roulers. Brazil has closed its legation in Vienna.

The Fourth Liberty Loan campaign was officially opened on the evening of Sept. 27 by President Wilson, who, in a speech in New York, declared there will be no bargaining with Germany. Drawing of numbers for the draft of men registered on Sept. 12 began in Washington on Sept. 30. The President addressed the Senate on Sept. 30 and urged it to adopt the Woman Suffrage resolution; the suffrage resolution was defeated in the Senate. The regulations for licensing platinum were issued on Sept. 30 by the War Industries Board and became effective the following day.

Fuel Requirements of the United States

According to the U. S. Fuel Administration, the present annual fuel requirements of the United States are about as follows:

The railroads of the country must have 166,000,000 tons; 125,000,000 tons will be required for domestic lighting, heating and cooking; 57,000,000 tons went into coke last year, and a considerably greater amount will be required for this purpose this year; 14,000,000 or 15,000,000 tons will be required to coal ships; public utilities will consume 35,000,000 tons; 13,000,000 tons will be used by the coal mines themselves to develop power, and 5,000,000 tons was estimated to be the amount needed for producing ice during last summer.

Some industrial needs are: Steel and rolling mills, 24,000,000 tons; brick, tile and clay products, 11,000,000; cement manufactories, 8,000,000; paper mills, 7,500,000; foundries and machine shops, 7,500,000; cotton mills (with Southern mills using wood wherever practicable), 5,000,000; meat packing and canning, 4,000,000; chemical factories, 3,250,000; glass makers, 3,000,000, and woolen mills, flour mills and lumber mills, 2,000,000 tons each.

Iron and Steel Prices Continued

The President has approved the agreement that was made by the price-fixing committee of the War Industries Board with the representatives of the iron ore, pig-iron and steel interests in regard to the continuance until Dec. 31 of the prices on iron ore and pig-iron and iron and steel products. Maximum prices now prevailing on these commodities are to be continued in effect for the rest of the year 1918, with the following exceptions, as given in the official announcement:

1. Lake Superior Iron Ore—Base prices of Lake Superior iron ore delivered to lower lake ports are increased 25c. per gross ton on and after Oct. 1, 1918, subject to the following condition: These increased prices are based on the rail freight rates now in effect and on the present lake rates, and in the event of any increase or decrease in either rail or lake rates said prices shall be increased or decreased accordingly on all deliveries made during the continuance of such increased or decreased freight rates.

2. Pig Iron—The base price on basic iron is increased to $33 f.o.b. furnace. The base price on No. 2 foundry iron is increased to $34 f.o.b. furnace. The price of standard bessemer iron is fixed at $35.20 f.o.b. furnace. The above prices are subject to the following changes from previous practice as regards delivery: (a) Pig iron produced in the Virginia, Tennessee, and Birmingham districts and the scattered districts south of the Ohio and Potomac rivers, including furnaces at St. Louis, Mo., but not including furnaces bordering on the Ohio River, shall be sold on an f.o.b. Birmingham, Ala., basis. (b) Pig iron produced in the Eastern district, that is, from all blast furnaces situated east of the Allegheny Mountains and north of the Potomac River, shall be sold on an f.o.b. Pittsburgh basis. (c) Pig iron from all other producing districts or furnaces shall be sold f.o.b. furnace, as heretofore.

No new contracts calling for delivery of any of the above commodities or articles on or before Jan. 1, 1919, are to specify a price unless coupled with a clause making the price subject to revision by any authorized U. S. Government agency, so that all deliveries after that date shall not exceed the maximum price then in force, although ordered or contracted for in the meantime.

All manufacturers and producers are expected to observe the maximum prices thus fixed.

Sweden Seeks Oil From Shales

The production of oil from oil shales or slates is receiving careful attention in Sweden, as in the United States. Shortage of oils of all kinds, for which war conditions are responsible, has been one of the greatest difficulties encountered in the former country. A résumé of the situation there, in this regard, has recently appeared in *Commerce Reports*, being reprinted from a Copenhagen newspaper. According to this, an alum shale is found in Sweden, especially in western Gotland, that is comparatively rich in oil and gives 5 to 6% of crude oil by distillation. The Scotch oil shales are said to yield about 8% by weight, but the Swedish formation can be more easily mined, it is claimed.

To produce an amount of crude oil equivalent to the 14,000 tons normally imported each year in the pre-war period by Sweden would require about 280,000 tons of the Swedish shale, it is reported. The country also imports normally about 128,000 tons of refined oil, equivalent to an additional 3,700,000 tons of shale. The total

imports are therefore equivalent to a total yearly production of 4,000,0000 tons of shale. The crude oil produced from this shale is said to yield about 70% of distilled oil much like petroleum in composition. The industry has been brought from the experimental to the practical stage and a company has been formed to develop and promote it.

Eight-Hour Day for U. S. Steel

The United States Steel Corporation has adopted the eight-hour basic day. This change in its policy became operative on Oct. 1, and affects the greater part of the 275,000 men engaged at the corporation's mills, mines, furnaces and transportation organizations. The eight-hour day will now be the basis for calculating wages and working periods for these employees, and it is expected that increases in wages in some departments will result. Announcement of the new order was made on Sept. 24 by Judge Elbert H. Gary, chairman of the board. The open-shop plan heretofore in force throughout the works will be continued.

United States Leads in Ferroalloys

"France before the war led in the production of ferroalloys, particularly as made by the electric process," says *Iron Age* editorially in its last issue. "Paul Girod was a pioneer in this field. His products were introduced in all steel-making centers of the world. Germany occupied a less prominent position, but her work in this line was growing in importance, particularly as regards control of the tungsten resources of Great Britain and as a seller of ferrotungsten to other countries. Great Britain had not yet awakened to the possibilities of ferroalloys, and the United States was not very far ahead of her.

"A striking transformation has taken place in the last four years. Today without doubt the United States leads the world in the production of all kinds of ferroalloys. More ferromanganese is produced here than in any other country, and it is not improbable that we may partly displace Great Britain as an exporter to Canada. These exports recently have grown larger with each month. In electrically made ferromanganese, rapid strides are being made here. And in ferrosilicon, both high and low grades, decided progress has been made recently in the electric grades.

"In other ferroalloys, particularly those of tungsten, chromium and molybdenum, as well as of vanadium and uranium, development has been noteworthy in this country as the war has progressed."

Henry R. Merton & Company

Henry R. Merton & Co. have been refused a license under the Non-Ferrous Metal Industry Act. This announcement was made by the president of the Board of Trade in the House of Commons on Aug. 6. It is assumed that unless some unexpected development occurs, the company will have to cease trading in the metals comprised within the terms of the act. Sir Albert Stanley, president of the Board of Trade, stated that formerly the Metallgesellschaft of Frankfurt held a large number of shares in Henry R. Merton & Co., but it holds none now. The Australian branch of the firm of Merton has been closed down. The present directors of the company are Messrs. S. Baer, H. Gardner, W. Gardner, O. Lang, E. R. Merton, and M. Wilson, all of whom are British subjects, but German subjects have an indirect financial interest in the company, says the *Ironmonger*, for Merton & Co. own 11,875 shares in a Swiss company which is believed to be under German control.

With the consent of the British government, Merton & Co. have recovered the whole of their shares held by enemies in return for the surrender of their own holdings in the Metallgesellschaft, but it now appears that although it has purged itself of its direct enemy associations, the company still falls under the first schedule of the Non-Ferrous Metal Industry Act. That schedule, under six headings, recites conditions, any one of which, if found applicable, precludes the grant of a license, unless the Board of Trade deems it expedient to grant one. Apparently, at present the board does not do so, and as Merton & Co. admittedly come within the conditions laid down in the first schedule, they have no right of appeal under Clause 5 of the act to a divisional court of the high courts. Such an appeal can be lodged only when there is a difference of opinion between the applicant and the Board of Trade as to the first schedule applying to the circumstances of his particular case.

Denmark To Receive Metal Supplies

Copper, iron, steel and other commodities to the extent of 352,895 metric tons annually will be exported to Denmark, according to Danish-American commercial and shipping agreements, that were successfully concluded and signed on Sept. 18 by the War Trade Board and a special Danish mission, after prolonged negotiations in Washington. The quantities of mineral, metal and related commodities included in the agreement are given as follows in metric tons:

Kerosene, gasoline, lubricating oils and greases, crude petroleum and dark refuses, 80,000, including not over 7000 tons of lubricating oils; copper and manufactures of copper, including brass, 3500; brass wire, 34; brass wire screens for paper making, 20; brass screws, 36; iron and steel products, 150,000; manganese dioxide, 600; nickel and manufactures, 14; antimony, 25; aluminum and manufactures, 132; lead and manufactures, 3000; tin and tin plate, quantity to be later agreed upon; zinc sheets, 300; zinc and manufactures, 2700; silver and manufactures, 14; sulphur, 270; zinc, lead and other paints, 2500; graphite, 100; asbestos (not crocidelite), 275; asphalt (not petroleum residue), 3250; talc, 150.

In addition to the above, sundry chemicals are included in the agreement, and various instruments for technical and scientific purposes, as well as machinery and parts, if approved. No articles so imported into Denmark are to be directly or indirectly reëxported to the Central Powers, under the terms of the agreement, nor to any neutral country where such exportation will release any commodity whatever for export to Germany or her allies.

Iron Mines in Tasmania may be purchased by the Australian Government to retain some control over the iron industries. Premier Watt announced on Aug. 29 that an option was being acquired to purchase the Blythe River iron mines for $550,000, with this end in view.

Remember the Comfort Fund of the 27th Engineers.

Industrial News from Washington

By Paul Wooton, Special Correspondent

War-Minerals Bill Ready for Signing

Owing to the active part taken by the President in urging the passage of the War-Minerals Bill, it is regarded as probable that he will sign the bill without delay. No intimation has come from the White House as to whom is being considered for administering the act. The prevailing opinion is that the powers will be divided between the War Industries Board and the Bureau of Mines. It is regarded as logical that matters of allocation and price-fixing would go to the War Industries Board, although the opinion has been expressed that a separate administrator will be named.

The House made little objection to the radical changes made in its bill by the Senate. In fact, Representative Stafford, of Wisconsin, declared that "the Senate bill is far superior and much more conservative than is the House bill." He said the House bill was "vicious in providing a guaranteed price on certain metals, regardless of the cost of production."

Such criticism as was expressed concerning the action of the conferees in departing so widely from the expressed opinion of the House was aimed at the increase in the appropriation from $10,000,000 to $50,000,000. Representative Mondell, of Wyoming, said "We can only approve the measure in the hope that conservatism will govern and control in the execution of this law. No doubt it can be made useful and helpful to the end that we shall secure the benefits of increased production of these minerals without entailing great losses on the Treasury or improperly interfering with orderly development with private capital."

In the course of the debate on the conference report, the following colloquy in regard to copper took place:

Mr. Slayden: Copper is one of the things that the Government does require in time of war, and Germany would give her very soul for plenty of it right now. It is true the Government does not propose to take over the copper mines. But the Government has done this thing, which I think is entirely unfair: It has compelled the copper producers to sell their product under the market value.

Mr. Foster: I think the copper producers of the country have not lost any money, I will say to the gentleman from Texas, on the price that the Government has fixed for copper.

Mr. Slayden: That is not the question. I think the gentleman will admit that the producer of any useful commodity, produced in an honorable way, is entitled to the market value.

Mr. Foster: He is entitled to reasonable compensation.

Mr. Slayden: He is entitled to the market value, in my judgment. That is the way I view cotton, and my friend from Arkansas, Mr. Wingo, and my friend from Tennessee, Mr. Garrett, no doubt, agree with me in that particular.

Mr. Foster: That is a question that we cannot settle here.

Mr. Slayden: For some time copper has been quoted in London at £122 per ton, which figures out to be 30c. lb., as I make it, while producers in this country were compelled to sell their copper at 23½c. a pound.

Mr. Wingo: I beg the gentleman's pardon. The producers of copper have been given a price which they themselves know is highly remunerative. I have been protesting against allowing them more than they were entitled to if the English price was made the basis.

Mr. Slayden: It was not fixed by themselves. They protested against the price. The English price, less freight, would be more profitable to the producers.

Mr. Foster: They may not be getting all they want, but they are getting all they ought to have.

Mr. Slayden: I do not think they are getting all they ought to have. I think they should get the market value.

Judging from the mail being received at the Bureau of Mines, a general impression seems to prevail in the mining districts that substantial aid is to be extended to those who desire to undertake the recovery of any of the war minerals. Prospectors have written the Bureau asking for everything from a donkey to a frying pan. Officials of the Bureau point out that the purpose of the bill is not to help mining but to secure supplies for the war. If mining or metallurgical enterprises need any form of subsidy or help, it is pointed out, separate legislation must be obtained.

Lead Rationing Working Well

The War Industries Board reports that the process of rationing lead is going along satisfactorily. The supply on hand at consumers' plants is sufficient for immediate needs. Government contracts are well taken care of. The situation has become no worse, and, if anything, it is a little better.

An additional demand on lead is being made by the use of foil in replacing tin tobacco containers. To conserve tin, a paper container is being used, which, however, requires the wrapping of the tobacco in lead foil. Even before this new demand, 4½% of the entire lead production of the country was going into foil.

Zinc Substituted for Other Metals

Makers of less essential products who use aluminum are being asked by Pope Yeatman to substitute ribbon zinc or other metals for aluminum wherever possible. The Eastman Kodak Co. has been particularly active in reducing the amount of aluminum used. Its use is also being restricted in cooking utensils, fireless cookers, toys, novelties, ornaments and in vacuum cleaners.

Considerable success is reported in the substitution of zinc for other metals. It now is being used in quantity for coffin linings, for boxes to be used as containers and in the manufacture of cans. The zinc rolling mills, Mr. Yeatman states, are showing the most commendable enterprise in their work in this direction.

Accident Problems Studied

Among the subjects considered at the fifth annual meeting of the International Association of Industrial Accident Boards and Commissions, which was held in Madison, Wis., Sept. 24 to 27, were the need for uniform reports of exposure to accidents; the use of standard accident and compensation tables; surgical treatment to prevent and to minimize permanent disabilities; compensation in cases of preëxisting disease aggravated by accident; crippled workers, and conservation and reclamation in the industrial army.

Regulations Issued for Licensing Platinum

MORE than 150,000 licenses must soon be issued under the regulations for handling platinum, which were published on Oct. 1. C. H. Conner, chief of the platinum section of the War Industries Board, made public with the regulations an explanatory statement, which, incidentally, is the first to be issued by the platinum section. Mr. Conner's statement is as follows:

The act of July 1, 1918, (Public No. 181), limiting the sale, possession and use of platinum, iridium and palladium and compounds thereof, provides that these metals are made subject to certain terms, conditions and limitations of the Explosives Regulations Act of Oct. 6, 1917.

Under Sec. 21 of the Explosives Act, the platinum section of the War Industries Board, Washington, D. C., has been created the agency to which all matters coming under this act pertaining to platinum, iridium and palladium and compounds thereof must be referred for license, details of which are set forth in a special circular.

The rules and regulations pertaining to this act have been prepared with much care and labor by a committee consisting of representatives of the Bureau of Mines, the U. S. Geological Survey, the Bureau of Standards and the War Industries Board.

In conformity with the authority delegated to the platinum section of the War Industries Board to administer the act, this opportunity is taken to outline, in a general way, the purposes to be accomplished and the policy to be pursued.

The two main purposes to be served by the enforcement of this act are:

First, the securing of a complete survey of the supplies of the platinum, iridium and palladium of the country through inventories of these metals, to be furnished at the time applications for licenses are submitted.

Second, to assist the Government in developing an adequate supply of these metals necessary for war purposes and other essential uses.

It will be the policy of the War Industries Board to disturb as little as possible, consistent with the administration of the act and the objects to be accomplished, the trades, industries, institutions and persons affected by the regulations.

Few people realize the importance of platinum in the war program. Platinum is one of the agencies employed, in very large quantities, in the production of sulphuric and nitric acid, necessary ingredients of explosives. It is also used in the manufacture of scientific and surgical instruments, such as cautery tips, hypodermic needles, etc.; electrical measuring instruments; X-ray tubes; fuses for firing the charges in guns of large caliber; contacts for telephone, telegraph and wireless systems; thermocouples for the regulation of furnaces in the heat treating of shells, guns, etc., and winding electric furnaces. Iridio-platinum contact points are absolutely essential for magnetos operating aëroplane engines; also for the successful operation of trucks, tractors and tanks on the battlefield. Chemical laboratories are dependent on platinum in making analyses and in furthering scientific development. The dental industry, which vitally affects the public health, requires a large amount of platinum and palladium.

The requirements, therefore, for platinum for war and essential purposes are large, and the supply is limited. The shortage is not at present critical, but may become so in the near future. The facts are, there is sufficient platinum on hand to carry the Government for a limited time, but there is no reserve stock. It is important—indeed a matter of vital necessity—that a reserve be built up for the future.

Russia has been the principal source of supply in the past. The chaotic conditions there have practically cut off that source. It therefore becomes necessary to develop an internal source of supply. Large quantities of platinum have been brought into the country in the past, and have found their way into trades, industries, chemical laboratories, etc. It is from these sources that the Government must largely depend for its requirements in the future.

In the administration of this act, the patriotic coöperation and assistance of all persons affected thereby is earnestly requested.

The Explosives Act was amended on July 1 by the addition of the following provisions:

Provided, That any license issued under the act of Oct. 6, 1917, may be canceled by the director of the Bureau of Mines if the person to whom such license was issued shall, after notice and an opportunity to be heard, be found to have violated any of the provisions of the act.

Provided further, That platinum, iridium, and palladium and compounds thereof are hereby made subject to the terms, conditions, and limitations of said act of Oct. 6, 1917, and the director of the Bureau of Mines is hereby authorized, under rules and regulations approved by the Secretary of the Interior, to limit the sale, possession, and the use of said material.

The regulations which will govern the handling of platinum were prepared by a committee consisting of Hennen Jennings, Bureau of Mines, chairman; C. L. Parsons, Bureau of Mines; C. H. Conner, War Industries Board; J. M. Hill, U. S. Geological Survey; and W. F. Hillebrand, Bureau of Standards. The regulations follow:

The following regulations are hereby promulgated under the provisions of the act of Oct. 6, 1917 (40 Stat., 395), as amended by the act of July 1, 1918 (Public, No. 181), authorizing the director of the Bureau of Mines, under rules and regulations approved by the Secretary of the Interior, to limit, during the period of the war, the sale, possession, and use of platinum, iridium, and palladium, and compounds thereof:

Sec. 1. The War Industries Board is hereby designated under Sec. 21 of the act of Oct. 6, 1917, and the President's proclamation of Oct. 26, 1917, as the agent of the director of the Bureau of Mines in the execution of the regulations as hereinafter indicated.

Sec. 2. From and after the date of these regulations, under the penalties prescribed by Sec. 19 of the act of Oct. 6, 1917[1], no person[2] shall:

Par. a. Use any platinum or platinum scrap, iridium or iridium scrap, palladium or palladium scrap, and/or compounds thereof, in the manufacture, alteration, or repair of any ornament or article of jewelry.

Par. b. Manufacture for use in dentistry any metal, metal parts, or alloys containing more than 20% by weight of platinum or 40% by weight of platinum, iridium, and/or palladium combined, or manufacture supplies therefrom.

Sec. 3. From and after the date of these regulations, under the penalties prescribed by Sec. 19 of the act of Oct. 6, 1917, no person shall without a license—

Par. a. Purchase, sell, barter, or deal in unmanufactured platinum, iridium, or palladium, or compounds thereof (including crude, scrap, filings, polishings, or sweeps), except that sales may be made without a license to an authorized agent of the United States or to a licensee authorized to purchase the same; or possess for more than 90 days after the date of these regulations one ounce troy, or more, of such unmanufactured platinum, iridium, palladium, or compounds thereof.

Par. b. Possess, use, sell, purchase or barter, for purposes connected with his business, platinum, iridium, palladium, or compounds thereof (except that sales may be made without license to an authorized agent of the United States, or to a licensee authorized to purchase the same), if such person be engaged in—

No. 1. Producing platinum, iridium, or palladium, or compounds thereof, by mining.

No. 2. Producing sulphuric acid, nitric acid, or other chemical products where platinum, iridium, palladium, or compounds thereof are used in such production.

No. 3. Importing or exporting platinum, iridium, or palladium, or compounds thereof.

No. 4. Producing platinum, iridium, or palladium, or compounds thereof, either as a primary product or as a byproduct of smelting or refining.

No. 5. Manufacturing electrical appliances and/or parts thereof containing platinum, iridium, or palladium, or compounds.

No. 6. Manufacturing surgical appliances and X-ray apparatus containing platinum, iridium, or palladium, or compounds thereof.

No. 7. Manufacturing chemical apparatus and reagents of all kinds containing platinum, iridium, or palladium, or compounds.

No. 8. Conducting or operating chemical laboratories in which platinum, iridium, or palladium, or compounds thereof, are used.

No. 9. Manufacturing scientific instruments containing platinum, iridium, or palladium, or compounds thereof.

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[1]Sec. 19 of the act of Oct. 6, 1917, is as follows:
"That any person violating any of the provisions of this act, or any rules or regulations made thereunder, shall be guilty of misdemeanor, and shall be punished by a fine of not more than $5000, or by imprisonment not more than one year, or by both such fine and imprisonment."

[2]The word "person," for the purposes of these regulations, shall be construed in accordance with the definition contained in Sec. 4 of the act of Oct. 6, 1917, which is as follows:
"That the word 'person' when used herein shall include states, territories, the District of Columbia, Alaska, and other dependencies of the United States, and municipal subdivisions thereof, individual citizens, firms, associations, societies, and corporations of the United States and of other countries at peace with the United States."

No. 10. Manufacturing and/or distributing dental supplies containing platinum, iridium, or palladium, or compounds thereof.

No. 11. Manufacturing and/or dealing in jewelry containing platinum, iridium, or palladium or compounds thereof.

No. 12. Manufacturing or producing any article or product not mentioned above where such business requires more than one ounce troy per month of platinum, iridium, or palladium or compounds thereof.

Sec. 4. Applications for licenses shall be made under oath to any licensing agent duly authorized under the act of Oct. 6, 1917, as provided in the regulations issued under this act.

Sec. 5. Every applicant for a license will be required to submit with his application a sworn inventory of all platinum, iridium, or palladium or compounds thereof in his possession or control; and every licensee will be required to submit at such times as may be designated by the War Industries Board a sworn inventory of his holdings of platinum, iridium, or palladium or compounds thereof in whatever form they may be.

The director of the Bureau of Mines, at the request of the War Industries Board, may at any time require from any user or possessor a detailed sworn inventory of any and all materials held by him containing platinum, iridium, palladium or compounds thereof, and such inventory must be furnished promptly upon receipt of such requirement.

Sec. 6. All licenses shall be issued in the name of the director of the Bureau of Mines and countersigned and delivered by the War Industries Board, and shall be and remain subject to the following conditions:

Par. a. Each license shall contain such appropriate conditions as the Bureau of Mines, through the War Industries Board, may impose.

Par. b. The Bureau of Mines, through the War Industries Board, may change the conditions of the license from time to time, as it may deem necessary.

Par. c. Records shall be kept by each licensee of all his sales, purchases and other transfers of platinum, iridium, or palladium or compounds thereof, and of articles containing platinum, iridium, or palladium or compounds thereof, with the names and addresses of the purchasers, sellers, and/or transferees, and the quantities involved, which records shall be open at all reasonable times to the duly authorized representative of the director of the Bureau of Mines.

Par. d. Any and all platinum, iridium, or palladium or compounds thereof, acquired under the authority of such license, shall be used strictly for the purposes and in the manner stated in such license.

Par. e. Upon request of the War Industries Board, the licensee shall report the prices at which sales of his products containing platinum, iridium, or palladium or compounds thereof are being made, and the right to prohibit further sale of such articles at prices deemed exorbitant by it is reserved to the War Industries Board.

Sec. 7. Any licenses issued hereunder may be revoked for violation of any of these regulations, or for violation of any of the conditions contained in such license, or if such revocation is deemed necessary or advisable for purposes of the national security and common defence.

Sec. 8. The War Industries Board will, upon request, furnish a list of Government agents or licensees authorized to purchase platinum, iridium, or palladium or compounds thereof. Neither the United States nor its representatives will assume any responsibility, financial or otherwise, where sales are made to licensees.

Sec. 9. The prices at which platinum, iridium, or palladium will be purchased by a duly authorized agent of the United States or by such licensee as may be authorized to purchase or sell platinum, iridium, or palladium or compounds thereof, will be such prices as may be determined by the proper Governmental agency authorized to determine such prices.

Sec. 10. Whenever such Government agents and such licensees as may be authorized to purchase platinum, iridium, or palladium or compounds thereof, shall refuse to purchase the same from any person who is compelled by these regulations to sell the same, or is forbidden by these regulations to possess or use the same, then such person shall promptly notify the platinum section, War Industries Board, Washington, D. C.

Sec. 11. These regulations shall not operate to relieve any person upon whom an order requisitioning platinum, iridium, or palladium or compounds thereof may have been or may hereafter be served, from any obligation imposed upon him by such order.

Sec. 12. These regulations are supplemental and amendatory to the regulations heretofore issued under the Explosives Act of Oct. 6, 1917.

The regulations are issued over the signature of Van. H. Manning, Director of the U. S. Bureau of Mines, and Franklin K. Lane, Secretary of the Interior. They were approved Aug. 17, 1918.

September Mining Dividends

The total amount disbursed as mining dividends in September, 1918, as was to be expected, showed a marked decrease from the payments in the corresponding month last year. However, only two or three companies found it necessary to pay less this quarter than they did in the preceding one, and the decreases were not great. The porphyry companies were among those which did not cut, from which it would appear that the increase in the price of copper has helped to counterbalance the prevailing high costs and other disturbing conditions.

United States Mining and Metallurgical Companies	Situation	Per Share	Total
Ahmeek, c	Mich.	$2.00	$400,000
Allouez, c	Mich.	1.50	150,000
Am. Sm. and Ref., com	U. S.-Mex.	1.50	914,970
Am. Sm. and Ref., pfd	U. S.-Mex.	1.75	875,000
Argonaut, g	Calif.	.05	10,000
Caledonia, l.s	Ida.	.03	78,150
Calumet & Arizona, c	Ariz.	2.00	1,284,960
Calumet & Hecla, c	Mich.	15.00	1,500,000
Chino, c	N. M.	1.00	869,980
Cons. Ariz. Sm., c	Ariz.	.05	83,150
Copper Range, c	Mich.	1.50	591,598
Cresson Cons., g	Colo.	.10	122,000
Eagle & Blue Bell, l.s	Utah	.10	(a) 89,315
Eastern Talc	Vt.	.15	10,433
Electric Point, c	Wash.	.03	23,812
Federal Min. & Sm., pfd	U. S.	1.75	209,757
Golden Cycle, g	Colo.	.03	45,000
Hecla, l.s	Ida.	.15	150,000
Homestake, g	S. D.	.50	125,580
Internat. Nickel	U. S.-Can.	1.00	1,673,384
Iron Cap, c	Ariz.	.25	36,203
Isle Royale, c	Mich.	.50	75,000
Kennecott, c	.....	1.00	2,787,028
Magma, c	Ariz.	.50	120,000
Nevada Con., c	Nev.	.75	1,499,593
Old Dominion, c	Ariz.	1.00	297,071
Oroville Dredg	Calif.	.12	82,385
Osceola, c	Mich.	2.00	192,300
Phelps Dodge	U. S.	(b) 8.00	3,600,000
Quincy, c	Mich.	2.00	220,000
Ray Con., c	Ariz.	.75	1,182,384
St. Joseph Lead	Mo.	.50	704,733
Tintic Standard, l. c	Utah	.08	93,400
Tonopah Ex., g. s	Nev.	.05	64,140
United Eastern, g	Ariz.	.05	68,150
Utah Con., c	Utah	.25	75,000
Utah Copper	Utah	2.00	3,248,980
Canadian Companies	**Situation**	**Per Share**	**Total**
Hedley, g	B. C.	$0.15	$36,000
Kerr Lake, s	Ont.	.25	150,000
Min. Corpn. of Can., s	Ont.	.18½	311,260
Holding Companies	**Situation**	**Per Share**	**Total**
General Dev	U. S.	.75	90,000
Yukon Alaska Trust	.....	1.00	203,433

(a) Payable in Liberty Bonds and War Savings Stamps.
(b) Payable $6 in cash, $2 in 4¼% Liberty Bonds.

The table shows that 36 United States mining and metallurgical companies in September, 1918, paid $23,553,456, compared with $34,463,831 paid by 43 companies in the corresponding month last year. Canadian companies paid $497,260, against $760,604 last year, and holding companies, $293,433, a decrease of $150,000 from last year.

Yukon Gold Co. discontinued its regular payments this quarter, the reason being the reduced income due to abnormally high cost of everything entering into gold mining.

The Phelps Dodge Corporation paid $8 this quarter, compared with $6 in June, 1918, but designated $2 as a payment from reserve for depletion, and distributed it in the form of 4¼% Liberty Bonds.

The Utah Consolidated reduced its quarterly payment from 50c. to 25c., and the General Development Co., from $1 to 75c. per share.

The totals for the first nine months of the year are as follows: United States mining and metallurgical companies, $129,528,608; holding companies, $1,728,438; Canadian, Mexican, Central and South American companies, $13,242,350.

Comfort Fund Gets Windfall

With the coming of autumn the leaves are falling, and one drifted into the office the other day all the way from the Mount Elliott mine in Queensland, Australia. It was a gum tree leaf[1] in the shape of a check for £20, which was accompanied by a message saying:

Just a little gum leaf toward the Comfort Fund for those great boys of America and from away back my greetings to them.

We are told that there are numerous eucalyptus trees in California, no doubt brought from Australia, and perhaps they have also followed the flotation oil to other localities. "Gum leaves" like the above are eagerly welcomed for the Comfort Fund and will be an evergreen token that friends have not forgotten the 27th Engineers.

HOW THE COMFORT FUND STANDS

Previously acknowledged	$14,436.50
H. Foster Bain	10.00
Marc Bailey	10.00
Charles Le Vasseur (second contribution)	10.00
William Wraith	25.00
H. A. Wheeler	10.00
Nevada Mine Operators' Association	100.00
Louis R. Wallace	50.00
H. P. Bowen	5.00
H. L. Brown and M. W. Hayward	16.00
Iron Cap Copper Co.	50.00
W. N. Smith	10.00
E. S. Geary	5.00
H. J. Wolf	10.00
F. H. Siebold	10.00
H. A. Kee	10.00
W. S. Grether	5.00
Marion J. Thomas	10.00
E. F. Eurich	10.00
Liberty Bell Gold Mining Co.	200.00
H. De Witt Smith	15.00
Associated Miners of the University of Idaho	10.00
New Idria Quicksilver Mining Co.	100.00
F. P. Burrall	25.00
Livingston Wernecke	5.00
E. P. Mathewson	50.00
Interest to June 26	82.61
H. W. Hixon	10.00
R. C. Canby	10.00
S. R. Guggenheim	10.00
Richard Tavis	5.00
Simon Guggenheim	100.00
J. V. Kelley	10.00
Algernon Del Mar	4.00
Sumner S. Smith	5.00
Will H. Coghill	10.00
Lincoln Crocker	10.00
C. E. Dewey	10.00
Plymouth Consolidated Gold Mines, Ltd.	100.00
United Eastern Mining Co.	50.00
W. A. Wilson	20.00
Oscar Lachmund (fifth contribution)	10.00
W. Rowland Cox	10.00
L. D. Huntoon	5.00
Alaska Mining and Engineering Society	50.00
W. R. Benedict	3.00
Etheredge Walker	25.00
Fritz Mella	25.00
Richard McCarthy	100.00
J. N. Houser	10.00
Weedon Mining Co.	50.00
William H. Kinnon	30.00
A. P. O'Brien	10.00
Lester W. Strauss	10.00
Montana Society of Engineers	50.00
W. R. Atkeson	2.50
Charles Le Vasseur (third contribution)	5.00
Frank Carroll	10 00
V. P. Hastings, Jr.	5.00
D. E. Woodbridge	5.00
Harvey B. Small	10.00
J. C. Porter	10.00
A. F. Taggart	10.00
G. E. Farish	25.00
H. K. Sherry	10.00
T. M. Hamilton	50.00
George O. Argall	10.00
C. T. R.	15.00
Oscar Lachmund (sixth contribution)	10.00
P. M. Arnold	10.00
W. A. Wolf	5.00
Employees of Utah Leasing Co., Newhouse, Utah	20.50
Employees of Braden Copper Co.	112.50
Charles A. Mitke (second contribution)	10.00
G. M. Colvocoresses	25.00
Charles Le Vasseur (monthly)	5.00
A. H. Wethey	25.00
S. Ford Eaton	25.00
H. H. Hunner	5.00
N. G. Thomson	25.00
Members of the A.I.M.E. meeting in Colorado Springs, Sept. 4, 1918	215.00
Glen Miles	25.00
J. B. Wilmarth	25.00
Frederick MacCoy	5.00
Balance of a certain Joplin contribution received through Lieut.-Col. Gilmore	590.36
H. V. Croll	5.00
American Zinc Institute	1000.00
Thomas H. Leggett	15.00
W. F. Pyne	10.00
Earl B. Crane	5.00
Hyram D. McCaskey	10.00
E. F. Salisbury	10.00
W. P. Ross	5.00
Edwin E. Chase	10.00
"Gum Tree," 20-pound check	93.00
Alex G. Keiller	10.00
Total	$18,485.97

Make your checks payable to W. R. Ingalls, treasurer of the Association of the 27th Engineers.

[1]We admit that the gum tree is an evergreen and that it is spring in Australia now. Anyhow we received the "leaf."—EDITOR]

Captain Irving's Death

We have received the following letter from Fred Searls to John Gray, describing the great work that Captain Irving had been doing and how he died. His multitude of friends will be glad to read this letter, speaking right from the heart, which we are authorized to publish.

France, July 28th, 1918.

Dear John:

This is the first opportunity I have had of writing you concerning Captain Irving's death. Poor old John; he literally worked himself to death. Died of pneumonia at midnight July 20th. The real story is this: He came down from the 11th to the Army Engineers' School last December and entered on the matter of developing and teaching dug-out construction to the A. E. F. It was a bit of far cry from his own work to come down to practical details of mine work. But he applied the same ability and tireless energy to it that he showed in other things, and he got ahead with it in a way that was remarkable. I can't tell you how much credit he deserves for it or how much use the work has been and will be to the army. I came down here at his request to help, and in the matter of previous experience and knowledge of such things I probably had quite an edge on him. But in accomplishment and learning the game, he passed me like an express train. He was the foremost authority over here on these things, and he leaves a lot of firm friends in the army game.

I was almost glad that we lost the Star decision, because I told him about it the last time I saw him conscious, and it cheered him up so much.

He was just getting out these new E. F. N. and was working all hours at G. H. Q. He came down here on the 9th, ill, and went to the hospital on the 11th, with this three-day fever that has been hitting us all. We thought nothing of it, and by the 15th he was much improved. The next day he suffered a relapse and developed pneumonia. We got expert doctors in consultation, and I can say truthfully that everything possible was done. He didn't have any resistance; was worn out, and he just got worse and worse until he died.

He was buried with full military honors in Cemetery 13, A. E. F., Grave 58.

I lost the best friend I've had in the army. In addition, he was my captain, and I had come to regard him in this respect in rather a different way from the old Butte days. He was a fine man, John, and it was good to serve under him.

I wrote to Kemp and to Irving's uncle in New York. Would you send a synopsis of this letter to Will Clark and to Winchell? I think they would be interested in knowing that John was accomplishing something worth while over here, and the details of his death.

As for me—I'm doing what I can; part of the time at the front and part at this school. Have seen some fighting and know what the game is. It's a tough one, and while I'm wishing I were in the infantry, I think I'll get plenty of chance before it's through. Our men are remarkable—with scant training and no experience they go in and clean everything up. It makes a man proud to be in this man's army. They're afraid of nothing and like the going. Heard a sergeant praising the Italians naively the other day: "Yes—they're all right; follow us anywhere." And the Yanks aren't following anybody, not even the veteran French heroes. Only Fritzie.

Guess that's enough optimism—looks like a long hard game to me.

Yours,
SEARLS.

Today is an opportune time to send a check for the Comfort Fund of the 27th Engineers.

Editorials

Trade Unions for Professional Engineers

"LABOR, from the aristocratic munition worker to the lowly scavenger, has shown us the power of organization, and now it is the turn of the higher grades to embrace trade unionism almost as a measure of self-preservation. Realizing that the government will recognize only those who are efficiently organized, the professional engineer seems to have had it driven home to him that if he is to be listened to, like the workmen whom he controls, he must combine. Therefore, we may shortly expect to find that the great bulk of those engaged in every branch of electricity supply, from the chief engineer downward to the workmen, will be organized in a trade union. So far as this particular branch of industry is concerned, dissatisfaction has been growing, because, while municipalities and the Committee on Production have constantly, under threats of strikes, granted increased wages to their workmen, they have as consistently ignored the professional men in their employ. Even chief engineers and their staffs, it is argued, feel the increased cost of living, and the way in which their claims have been neglected has been largely responsible for a step which cannot fail to have a material influence on the industries of the country. The decision has been come to with considerable reluctance, but conditions have made it essential that there should be this extension of trade unionism, which may be expected to spread to all forms of public utility and similar undertakings. Are we in for strikes of the chief engineers and their staffs, and will London come out in sympathy with other towns, or *vice versa?* Some interesting possibilities are foreshadowed, and the workman may yet find himself unable to work because his chief has 'come out.'"

We quote the above from our esteemed British contemporary, the *Ironmonger*. We do not take it seriously, but as a humorous idea that is incisive there is much in it. We use the designation "engineers" in a different sense from what they do in Great Britain. Adhering to our own vernacular, suppose the engineers of the country should unionize themselves and go out on strike for shorter hours, higher wages, time and a half for overtime and double time for Sundays and holidays. Everybody knows that they have meritorious claims for generous consideration on all of those grounds. How long would our railways, factories and mines run without them? Russia may give an answer, though not owing to the intelligentsia going out on strike, but rather to the mistaken idea of the proletariat that knowledge and experience are unnecessary. Flooded mines, frozen furnaces, and wrecked railways soon furnished object lessons to the contrary.

American engineers will never unionize themselves and strike; for ideas of patriotism, industry and efficiency that have been bred into them forbid. Waste of material and waste of time are equally abhorrent to the men of this profession. Their minds are imbued with the governing idea of accomplishment. They have no thought that conflicts with the wish to do a full day's work and do the most in that day that can possibly be done. Their greatest achievements are when they reduce cost of production. Then they feel that they have done something whereof they can be proud; and so they can, for they have contributed to the material benefit of all of their fellow men. The engineer loves his work and gets his greatest pleasure in doing it. His remuneration is to him a subordinate consideration. Both capitalists and labor unions take advantage of him, when they ought to cherish him and be very kind to him. But we are glad that engineers are just as they are, and our country has reason to be glad about having them in the emergencies of the last 18 months.

Is Cotton Still Immune?

THE irate senators from the South gave Mr. Baruch an uncomfortable quarter of an hour—or hour and a quarter—when the news circulated that he was going to cause a price to be fixed for cotton and they rushed to his office and told him to keep his hands off. But upon reference to the President, the latter supported Mr. Baruch to the extent of causing two commissions to be appointed to look into the matter. Nothing less could have been done, in view of the circumstances.

Since then the affair seems to have been dropped. There have been intimations from the price-fixing commission, through the press, that perhaps it will not be necessary to fix any price for cotton. This will be good news, if true, to the Southern senators and their constituents, but it will not be so popular in the West, where copper and lead are produced.

The Comparative Friability of Ores

IN A PAPER recently submitted to the American Institute of Mining Engineers, the author, Luther W. Lennox, dealt with a factor in ore-dressing operations from an apparently new aspect. The investigations described were the result of an attempt to determine the relative resistance of different ores to uniform crushing and grinding strains. The apparatus used was a small model tube mill carrying an even load of small steel balls. The ores to be tested were coarsely crushed and graded to provide uniform samples, of which definite amounts were introduced into the mill, together with a definite amount of water. The machine was then revolved at a fixed rate for a predetermined time, and the amount of material abraded or broken to a certain dimension taken as representing the comparative friability of the ore, or, conversely, the resistance to crushing strains and grinding actions. The Rittinger system of computing results on the basis of surface exposed was adopted in subsequent calcu-

lations, and curves were plotted to show apparent work done, which would be inversely proportional to the resistance of the particular ore, other conditions being equal. Figures are given to show the comparative resistability of a number of ores from well-known mines in the United States and Alaska, as determined by this method, and the results are undoubtedly of interest and value. The author of the paper describes refinements of calculation intended to make the results as correct as possible, particularly with reference to work done on minus 200-mesh material. It is not claimed that the method is complete or absolutely accurate, but Mr. Lennox avers, with justification, that the results should give an indication of the relative resistance of the ores to crushing and grinding strains.

For a number of years experiments have been carried out in different parts of the world for the purpose of perfecting a method of computing the relative mechanical efficiency of crushing and grinding machines of various types on the same ore, by means of an estimate of work done, as calculated with the help of either of the well-known laws of Kick or Rittinger, and a knowledge of the power expended. By maintaining uniform conditions with regard to the machine and the power needed, and by varying the character of material used in the experiments, it is possible to estimate the comparative friability of the ores with no greater error than that introduced by the difficulty of calculating the exact dimensions of the particles produced.

The method proposed by Mr. Lennox for estimating the comparative values of certain physical characteristics of ores is not entirely new, although it may appear novel to the mining fraternity. In our issue of June 6 there was published an article entitled "Artificial Pebbles for Tube Milling," in which an account was given of the Deval abrasion machine, used for the purpose of determining what civil engineers term the French coefficient of wear, as applied to the requirements for road-building rock. Comparative resistance is calculated in an almost identical way to the method described above, except that the tube mills used are set with inclined axes so as to give maximum bruising effect, and no steel balls are used. The conclusions are, moreover, based on a less accurate determination of the sizes of the products.

The question of the relative friability of ores and also the pebbles required to crush them is receiving an increasing amount of attention. The experimental work done by the Office of Public Roads and Rural Engineering has resulted in a great deal of information of value to other industries; and Mr. Lennox's paper, which was recently discussed at the Colorado meeting of the Institute, will facilitate the solution of many a grinding problem. His method suggests a simple system of determining facts which will materially influence the design of crushing plants, and will aid in the work of forecasting, with greater accuracy than is possible at present, the equipment necessary. Another important field for the method will be found in connection with comparisons of the efficiencies of various crushing machines operating on different ores in different localities. The data which will be available will aid in explaining the phenomenal duties achieved in some instances and the somewhat inexplicably low ones in others.

Sheet Zinc for Roofing

WE ARE republishing, this week, at the request of some of our readers, an article on the use of sheet zinc for roofing purposes, by W. H. Seamon, that appeared originally in the *Journal* of Oct. 24, 1896, continuing as a series through several subsequent issues. The article is just as interesting and valuable now as it was 22 years ago. It was introduced by the following editorial:

> On another page we give the first part of a paper on the applications of zinc to roofing and other purposes, which ought to interest many readers. It is well understood that at the present time the productive capacity of our zinc mines and smelting works is in excess of the demand for spelter, while exports of any considerable quantity to Europe are possible only at the risk of a disastrous break in prices. How this condition has come about it is useless to inquire; it exists, and the only remedy for miners and smelters is to find new uses for the metal. The employment of sheet zinc for roofs is quite common abroad, though almost unknown here. Its adoption for that purpose, for which it is very well suited, would create a new and important market for the metal, which would be of great advantage to the trade. The article referred to is a thoroughly practical one, and gives very fully the best methods of handling and applying zinc for the purpose, besides setting forth the advantages obtained by its use.
>
> It is in such directions as this that future gains for the zinc trade are to be found. The establishment of a new source of demand is of far more permanent importance than any temporary increase in price through a trust or combination; and is, moreover, a legitimate gain, which will be felt not only now but for a long time to come.

Except for the reference to exports of spelter to Europe, the above editorial reads as well, is just as pertinent, and gives as good advice as if it had been written last night, instead of 22 years ago. The economic policy of the *Journal* with respect to legitimate trade developments was just the same then as it is now.

Tonopah Mining Costs

IN THIS issue we present an excellent summary of comparative costs of silver mining in Nevada by Jay A. Carpenter. Mining costs in Nevada are peculiarly illuminating in that they represent conditions unlike those pertaining to other Western states, with the possible exception of Arizona. Practically all supplies must be brought in from considerable distances and at comparatively high freight rates. Machinery and labor are also brought from distant centers. Water must be developed at high cost. Living conditions are not particularly attractive. The mines are deep, and a large proportion of development work is necessary. Orebodies are often of limited extent. Ore treatment requires excessively fine grinding. Only in the power cost does the Tonopah district appear to have any advantage, and this is due to fortuitous circumstances.

The result of Mr. Carpenter's comparison shows that the increased price of silver has not brought increased profits, but has merely maintained equilibrium. In this the Tonopah operators are fortunate. We doubt whether the situation is as good as Mr. Carpenter's conclusion would lead us to believe. In our last issue, we published a letter by George E. Collins that throws an additional light upon the subject of mining costs at precious-metal mines under present conditions. Mr. Collins shows how the practice of exacting economy in all directions has made it possible for some gold mines to continue in operation and even to maintain a sem-

blance of profit. Without doubt the excellent showing of the Tonopah district is due in a large measure to the practice of similar economies. Credit must be given to foremen, superintendents and managers for their skill and devotion to duty in this as well as in other districts.

Miners Leaving Alaska

ACCORDING to a dispatch from Dawson, Y. T., dated Sept. 26, a sudden exodus of miners and their families from the Yukon and Alaska has begun. The increased cost of labor and of all mining supplies and goods is responsible for the numerous departures from the district. Every boat arriving at Dawson during the last few weeks from Ruby, Fairbanks, Iditarod and other Alaskan camps comes with the accommodations taken by people leaving the country for the Pacific Coast, where there is hope of obtaining work in war industries at high wages until after the war.

This dispatch serves to emphasize the statements of P. C. Stoess, whose article on "Mining in Alaska Under War Conditions" appears on another page of this issue. Mr. Stoess has just returned from that territory and has painted a rather gloomy picture of the difficulties which must be met by all mining companies there, with few exceptions.

If labor be allowed to eat up all profits, which are limited by fixed prices; and if labor does not save and goes untaxed anyhow, who is going to pay the stupendous levies that Mr. Kitchin and his colleagues are framing? The professional and salaried classes who are dependent upon fixed incomes, and the old people whose sole income is derived from bonds, into which they put the savings of their youth, have some grave things to think about. Certainly they have no powerful friends who are looking out for them.

BY THE WAY

As a part of a safety program of a Minnesota mining company, it has been the custom for each mine to hold a monthly meeting, at which safety measures, including a discussion of the accidents which had happened during the month previous, were studied by those present. The personnel of the committee was changed from month to month and so chosen that all departments of the mine organization were represented. The company operated several mines in the district, so that a comparison as to what had been done along lines of accident prevention at each was available, and a certain rivalry existed among the different mines.

During a recent month the Saginaw mine operated for the entire period without an accident, and, as an average of 200 men was employed, the record was regarded as remarkable. The chairman of the safety meeting, which was held at the Siam mine the month following the establishment of the record, concluded his remarks with: "You see, gentlemen, what the boys at the Saginaw have done. Two hundred men working and not an accident! What they have done, we can do, and next month we must tie the record." With the intention of leaving this last thought, he was about to dismiss the meeting when he was interrupted by Dicky, one of the Cornish shift bosses who was on the committee that month: "See 'ere, now. I 'as been listenin' to this 'ere bit, an' seems to me them there bloody beggars over to Saginaw mine 'as it far from truthful. Why, damn-me, m' son, I naws bloody well that you or me would 'ave one 'el of a time jus' marchin' two 'undred to church without 'urt, say nothin' of workin' they!"

Mining Industry and the Liberty Loan

As in the Third Liberty Loan, a special Advisory Trades Committee has been appointed in New York, with various sub-committees covering different lines of business, the object being for each committee to bring the loan before every firm and individual in its respective group and secure their subscriptions.

Following are the members of the special Mining Industry Committee: Charles Hayden, chairman; W. B. Thompson, vice chairman; Marshall M. Ferguson, secretary; Sherwood Aldrich, W. A. Bostwick, Arthur V. Davis, E. P. Earle, Daniel Guggenheim, John Hays Hammond, J. G. Hopkins, W. R. Ingalls, C. F. Kelley, D. C. Jackling, Arthur C. James, S. J. Jennings, Adolph Lewisohn, C. M. Loeb, Charles M. MacNeill, C. W. Nichols, Edgar Palmer, F. Y. Robertson, E. N. Skinner.

Total subscriptions to the Third Liberty Loan obtained through the special Liberty Loan Committee for the mining industry amounted to $27,967,750. In the present loan the new and increased quota for the mining industry committee is $40,000,000.

Following are subscriptions received up to and including Oct. 1:

Arthur Feust	$500
Robert Peele	2,000
C. D. Kaeding	1,000
Mrs. C. D. Kaeding	100
L. Vogelstein & Co., Inc.	500,000
U. S. Smelting, Refining and Mining Co. and subsidiaries	750,000
O. B. Perry	5,000
Coronet Phosphate Co.	10,000
Howard & Co.	500
Edward W. Lawler	200
Charles A. Bohn	100
H. A. Guess	5,000
Fred Hellmann	10,000
Charles K. Lipman	5,000
P. A. Mosman	1,000
Great Western Smelting and Refining Co.	100,000
American Metal Co., Ltd.	1,000,000
Cerro de Pasco Copper Co.	500,000
C. H. Munro	1,500
Judd Stewart	17,000
Charles A. Burdick	200
Robert H. Cromwell	100
H. W. Hardinge	10,000
Josef Radnai	200
George W. Feakins	900
Adolph Lewisohn and Sons	500,000
New Jersey Zinc Co.	2,000,000
Officers of New Jersey Zinc Co.	80,000
Albert R. Ledoux	20,000
Employees, Albert R. Ledoux	6,100
Frank Wilson	1,000
Whittaker, Clark & Daniels, Inc.	2,600
Phelps Dodge Corporation	1,000,000
James McLean	250,000
Thompson, Weinman & Co.	1,100
Big Ledge Copper Co.	50,000
Frederick Taber Rubidge	1,000
Lewis C. Beaumont	1,000
Inspiration Consolidated Copper Co.	1,000,000
Greene Cananea Copper Co.	500,000
G. P. Bartholomew	2,500
G. T. Bridgman	1,000
Total	$8,336,600

It should be noted that the Mining Industry Committee covers only the New York Federal Reserve District, and the amount by no means represents the entire mining industry and its patriotic response to the Liberty Loan appeal.

Headquarters of the committee are at 25 Broad St., Room 811, New York City.

The Mining Index

This index is a convenient reference to the current literature of mining and metallurgy published in all the important periodicals of the world. We will furnish a copy of any article (if in print) in the original language for the price quoted. Where no price is quoted the cost is unknown. Inasmuch as the papers must be ordered from the publishers, there will be some delay for the foreign papers. Remittance must be sent with order. Coupons are furnished at the following prices: 20c. each, six for $1, 33 for $5, and 100 for $15. When remittance is made in even dollars, we will return the excess over an order in coupons if so requested.

COPPER

9852—ANALYSIS—A New Method of Determining Copper. James Moir. (Journ. Chem., Met. and Min. Soc. of So. Afr., May, 1918; 1 p.) Discussion of article previously indexed.

9853—ARIZONA—New Cornelia Copper Co.'s Plant a Success. R. B. Leach. (Min. and Oil Bull., July, 1918; 4½ pp., illus.)

9854—LEACHING—Lexiviacion de Minerales de Cobre por Medio del Amoniaco. Pedro Alvarez. (Bol. Soc. Nacional de Mineria, Jan., Feb., Mar., 1918; 8½ pp., illus.)

9855—MINING METHOD—Method of Mining Pillars at the Fortuna Mine of the Braden Copper Co., Chile. Chas. Hollister. (Eng. and Min. Journ., Sept. 14, 1918; 2 pp., illus.) 20c.

9856—QUEENSLAND—The Arbouin Copper Mines at Cardross on the Chillagoe Mineral Field, North Queensland. Lionel C. Ball. (Pub. No. 261, Dept. of Mines, Queensland Geol. Surv., 1918; 70 pp., illus.)

9857—QUEENSLAND—The Cloncurry Copper District of Queensland. W. H. Carbould. (Eng. and Min. Journ., Sept. 7, 1918; ¾ p.) 20c.

9858—REFINING—Recovery of Selenium and Tellurium in Copper Refining. M. H. Merriss and H. T. Binder. (Eng. and Min. Journ., Sept. 7, 1918; 2¾ pp.) 20c.

GOLD AND SILVER—GEOLOGY

9859—ALASKA—The Upper Chitina Valley, Alaska. Fred H. Moffit, with description of the Igneous Rocks by R. M. Overbeck. (Bull. 675, U. S. Geol. Surv., 1918; 82 pp., illus.)

9860—ONTARIO—Gold Deposits in MacMurchy and Churchill Townships. (Can. Min. Journ., Aug. 15, 1918; 5½ pp., illus.)

GOLD AND SILVER—CYANIDING

9861—LEAD SALTS—The Supply of Lead Salts for Use in Cyanide Plants. Thos. B. Stevens. (Monthly Journ. Chamber of Mines of West Australia, May 31, 1918; 1½ pp.)

9862—SOLUTIONS—The Estimation of Oxygen in Working Cyanide Solutions. H. A. White. (Journ. Chem. Met. and Min. Soc. of So. Afr., June, 1918; 5 pp.) 60c.

GOLD AND SILVER—GENERAL

9863—COLORADO—Mining in the Telluride District of Colorado. Harry J. Wolf. (Eng. and Min. Journ., Aug. 31, 1918; 4¾ pp., illus.) 20c.

9864—COLORADO—Ore Treatment in Colorado. (Eng. and Min. Journ., Aug. 31, 1918; 2¾ pp.) 20c.

9865—EASTERN STATES—Gold, Silver, Copper, Lead and Zinc in the Eastern States in 1917. James M. Hill. Mineral Resources of the U. S., 1917—Part I; 11 pp.)

9866—PRODUCTION—The Importance of Gold Production. Lionel Phillips. (Min. and Sci. Press, Aug. 3, 1918; 2½ pp.)

9867—STAMP MILLING—Electric Furnace Manufacture of Shoes and Dies on the Witwatersrand. Geo. H. Stanley. (Journ. Chem., Met. and Min. Soc. of So. Afr., May, 1918; 2½ pp.) Reply to discussion of article previously indexed.

IRON ORE DEPOSITS, MINING, ETC.

9868—FRANCE—Iron and Coal in France After the War. (Iron and Coal Tr. Rev., May 24 and Aug. 9, 1918; 2½ pp.)

9869—IRELAND—Iron Ore in Ireland. (The Statist, Aug. 17, 1918; 1 p.)

IRON AND STEEL METALLURGY

9870—BLAST-FURNACE PRACTICE—Correcting Air Volume for Blowing. L. C. Loewenstein. (Iron Tr. Rev., Sept. 12, 1918; 7¾ pp., illus.) Paper before Am. Soc. Mechan. Engrs. 20c.

9871—COLD-WORK—The Effect of Cold-Work on the Divorce of Pearlite. J. H. Whiteley. (Advance copy, Iron and Steel Inst., May, 1918; 9 pp., illus.)

9872—ELECTRIC FURNACE—The Webb Electric Steel Furnace. (Iron Age, Aug. 1, 1918; 3 pp., illus.) 20c.

9873—ELECTRIC STEEL—War Industries Board Discourages Further Expansion of Electric Steel. (Chem. and Met. Eng., Aug. 15, 1918; 1½ pp.)

9874—FERROALLOYS—The Manufacture of Ferroalloys in the Electric Furnace. Robert M. Keeney. (Bull. A. I. M. E., Aug., 1918; 53 pp.) 40c.

9875—GALVANIZING—Modern Practice of Galvanizing Sheets. Clement F. Poppleton. (Iron Age, Aug. 29, 1918; 3½ pp., illus.) 20c.

9876—HEAT TREATMENT—Effect of Mass on Heat Treatment. E. F. Law. (Advance copy, Iron and Steel Inst., May, 1918; 15 pp., illus.)

9877—IRON, CARBON AND PHOSPHORUS. J. E. Stead. (Advance copy, Iron and Steel Inst., May, 1918; 24 pp., illus.)

9878—METALLOGRAPHY and Heat Treatment of Metals Used in Aeroplane Construction. F. Grotts. (Chem. and Met. Eng., Aug. 1, 15 and Sept. 1, 1918; 20 pp., illus.) First three of a series of articles dealing with cast iron, steel, aluminum, copper, bronze and brass, typical examples of investigations of aeroplane parts, with microphotographs and results of physical and chemical tests.

9879—ORE BRIDGE—Bethlehem Ore Bridge Built in 65 Days. (Iron Age, Aug. 22, 1918; 1¼ pp., illus.) 20c.

9880—POWDERED COAL—A Diversified Application of Powdered Coal. Chas. Longnecker. (Iron Age, Sept. 12, 1918; 4¼ pp., illus.) The pulverized fuel is distributed by compressed air to sub-stations and used in open-hearth, annealing and other furnaces. 20c.

9881—RUSSIA—Iron and Coal in Russia Before the War. (Iron and Coal Tr. Rev., Aug. 16, 1918; 2 pp. illus.)

9882—SILICOMANGANESE Supply is Assured. (Iron Tr. Rev., July 11, 1918; 1 p., illus.) 20c.

9883—STEEL PLANT—The Keystone Steel and Wire Co., a Steel Plant of the Middle West. F. B. Crosby. (Gen. Elec. Rev. May, 1918; 12 pp., illus.) 20c.

LEAD AND ZINC

9884—BURMA—Geology and Ore Deposits of the Bawdwin Mines. J. Coggin Brown. (Geol. Surv. of India, Vol. XLVIII Part 3, 1917; 58 pp.)

9885—FLOTATION—Differential Flotation at Wallace, Idaho C. T. Rice. (Eng. and Min. Journ., Sept. 14, 1918; 2 pp., illus.) 20c.

9886—METALLURGY—La Metallurgia dello Zinco. Erminio Ferraris. (L'Industria, Vol. XXXII, No. 10, 1918; 8 pp.)

9887—QUEENSLAND—Mount Prospect Silver-Lead Lode Cania. W. E. Cameron. (Queensland Govt. Min. Journ., July 15, 1918; 1¼ pp.) 60c.

9888—SMELTERY—The Blast-Furnace Charge of the Bunker Hill Smeltery. C. T. Rice. (Eng. and Min. Journ., Sept. 7, 1918; 2¾ pp., illus.) 20c.

OTHER METALS

9889—ALUMINUM and Its Light Alloys. Paul D. Merica. (Chem. and Met. Eng., Aug. 1 and 15, 1918; 8½ pp., illus.) To be continued.

9890—ALUMINUM—Procedimientos Actuales de Fabricacion de Aluminio. Juan Escard. (Bol. Soc. Nacional de Mineria Jan., Feb., Mar., 1918; 18½ pp., illus.)

9891—ANTIMONY—Blast-Furnace Smelting of Stibnite with Considerations on the Metallurgy of Antimony. W. R. Schoeller. (Bull. 165, I. M. M., June 27, 1918; 3 pp.) Author's reply to discussion of paper previously indexed.

9892—CHROME AND MANGANESE ORES in Cuba, Investigation by Government Bureaus. (Press Bull., U. S. Geol. Surv., Sept., 1918; 8 pp.)

9893—CHROMITE. Albert Burch and Samuel H. Dolbear. (Pamphlet Pub. by Min. and Sci. Press, 1918; 31 pp., illus.)

9894—COLORADO—War Minerals of Colorado. A. H. Hubbell. (Eng. and Min. Journ., Aug. 31, 1918; 2½ pp.) 20c.

9895—MANGANESE—Le Miniere di Manganese Italiane. Gaetano Castelli. (Rassegna Mineraria, Apr., 1918; 2½ pp.)

9896—MANGANESE and Manganiferous Ores in 1916. D. F. Hewett. (Mineral Resources of the U. S., 1916—Part I; 26 pp., illus.)

9897—MANGANESE DEPOSITS of East Tennessee. G. W. Stose and F. C. Schrader. (Vol. VIII, Resources of Tenn., July, 1918; 55 pp., illus.)

9898—MANGANESE MINING in the Magdalena Mining District, New Mexico. R. H. West. (Eng. and Min. Journ., Sept. 7, 1918; ¾ p.) 20c.

9899—MOLYBDENITE—Simpson's Molybdenite Find, in the Connors Range Near Cardowan, Central Queensland. Lionel C. Ball. (Queensland Govt. Min. Journ., July 15, 1918; 1¾ pp., illus.) 60c.

9900—MOLYBDENUM—Ilsemannite. H. F. Yancy. (Chem. and Met. Eng., Aug. 15, 1918; 5 pp.) Results of a study of a blue, water-soluble molybdenum compound occurring in Utah; methods of analysis and results of extraction tests.

9901—MONAZITE in Mergui and Tavoy, India. A. M. Heron. (Rec. Geol. Surv. of India, Vol. XLVIII, Part 3, 1917; 1 p.)

9902—QUICKSILVER—The Position of the Quicksilver Producers in California. (Eng. and Min. Journ., Sept. 7, 1918; 3¾ pp.) 20c. Report by H. W. Gould at conference in San Francisco before U. S. Tariff Commissioner and consulting metallurgical engineer of the commission.

9903—QUICKSILVER AND TUNGSTEN. Production of Quicksilver and Tungsten, as Discussed Before the U. S. Tariff Commission at San Francisco. (Min. and Sci. Press, July 6, 1918; 4 pp., illus.) 20c.

9904—RHODESIA—Minerals of Rhodesia. A. E. V. Zealley. (Report of Rhodesia Munitions and Resources Committee, 1918; 6 pp.)

9905—RHODESIA—The Steel-Hardening Group of Metals in Rhodesia. F. P. Mennell. (Report, Rhodesia Munitions and Resources Committee, 1918; 3 pp.)

9906—TIN—Economies in Use of Tin; Savings Found in Babbitt Manufacture, Other Alloy Castings and in Solder. State-

ment by the Tin Section of the War Industries Board. (Metal Ind., July, 1918; 1½ pp.; also Iron Age, June 27, 1918; 1¼ pp.) 20c.

9907—TIN—Solder Without Tin. Chas. W. Hill. (Chem. and Met. Eng., Aug. 15, 1918; 1 p., illus.)

9908—TUNGSTEN Within the Empire. Sydney J. Johnstone. (Journ. Soc. Chem. Ind., Aug. 15, 1918; 2 pp.)

9909—VANADIUM—Metodos de Valoracion de Vanadio en los Ferrovanadios. Vicente Garcia Rodeja. (Revista Minera, July 16, 1918; 2½ pp.)

NONMETALLIC MINERALS

9910—ASPHALT DEPOSITS and Oil Conditions in Southwestern Arkansas. Hugh D. Moser and A. H. Purdue. (Bull. 691-J, U. S. Geol. Surv., Aug., 1918; 22 pp., illus.)

9911—CLAY—Kaolin in Quebec. J. Keele. (Journ. Am. Ceramic Soc., Jan., 1918; 6 pp., illus.)

9912—CLAY—Report on the Clay Resources of Southern Saskatchewan. N. B. Davis. (Mines Branch, Can. Dept. of Mines, 1918; 93 pp., illus.)

9913—CLAY DEPOSITS in Petrie's Paddocks, North Pine River. H. I. Jensen. (Queensland Govt. Min. Journ., July 15, 1918; ½ p.)

9914—FELDSPAR in 1917. Frank J. Katz. (Mineral Resources of the U. S., 1917—Part II; 6 pp., illus.)

9915—GEMS AND PRECIOUS STONES in 1917. Waldemar T. Schaller. (Mineral Resources of the U. S., 1917—Part II; 24 pp.)

9916—POTASH—El Salar de Pintados i sus Yacimientos de Potasa. J. Bruggen. (Bol. Soc. Nacional de Mineria, Jan., Feb., Mar., 1918; 17 pp., illus.)

9917—RHODESIA—Minerals of Rhodesia. A. E. V. Zaelley. (Report, Rhodesia Munitions and Resources Committee, 1918; 6 pp.)

9918—RHODESIA—Notes on Some Non-Metallic Minerals. F. P. Mennell. (Report, Rhodesia Munitions and Resources Committee, 1918; 3¼ pp.)

9919—SALT—Saline Domes and Other Salt Deposits. Kirby Thomas. (Min. and Sci. Press, Aug. 17, 1918; ¾ p.)

9920—SALT MINING and Dressing. J. B. Calkins. (Eng. and Min. Journ., Sept. 7, 1918; 4¼ pp., illus.) 20c.

9921—SILICA in 1917. Frank J. Katz. (Mineral Resources of the U. S., 1917—Part II, 5 pp.)

9922—SLATE in 1917. G. F. Loughlin. (Mineral Resources of the U. S., 1917—Part II; 18 pp.)

9923—SULPHUR—Our Sulphur Supply. (Editorial, Eng. and Min. Journ., Aug. 31, 1918; 1 p.) 20c.

9924—SULPHUR in Jemez Canyon, New Mexico. Philip S. Smith. (Eng. and Min. Journ., Sept. 7, 1918; ½ p.) 20c.

9925—TALC—Report on Certain Minerals Used in the Arts and Industries. Percy A. Wagner. (So. Afr. Journ. of Ind., June, 1918; 6 pp.)

9926—TRIPLITE: A Possible Source of Phosphoric Acid. A. E. V. Zealley. (Report, Rhodesia Munitions and Resources Committee, 1918; 2½ pp.)

PETROLEUM AND NATURAL GAS

9927—ARKANSAS—Asphalt Deposits and Oil Conditions in Southwestern Arkansas. Hugh D. Miser and A. H. Purdue. (Bull. 691-J, U. S. Geol. Surv., Aug., 1918; 22 pp., illus.)

9928—NORTH DAKOTA—The Nesson Anticline, Williams County, North Dakota. A. J. Collier. (Bull. 691-G, U. S. Geol. Surv., Aug. 15, 1918; 7 pp., illus.)

9929—TENNESSEE—The Glenmary Oil Field. L. C. Glenn. (Vol. VIII, Resources of Tenn., July, 1918; 9 pp.)

9930—WYOMING—The Salt Creek Oil Field, Wyoming. Carroll H. Wegeman. (Bull. 670, U. S. Geol. Surv., 1918; 52 pp., illus.)

ECONOMIC GEOLOGY—GENERAL

9931—ALASKA—The Upper Chitina Valley, Alaska. Fred H. Moffit, with description of the Igneous Rocks, R. M. Overbeck. (Bull. 675, U. S. Geol. Surv., 1918; 82 pp., illus.)

9932—DEPTH AND THICKNESS OF STRATA—New Graphic Method for Determining the Depth and Thickness of Strata and the Projection of Dip. Harold S. Palmer. (Prof. Paper 120-G, U. S. Geol. Surv., Aug. 21, 1918; 6 pp., illus.)

9933—HOLLANDITE—On the Crystallography and Nomenclature of Hollandite. L. Leigh Fermor. (Records of the Geol. Surv. of India, Vol. XLVIII, Part 3, 1917; 18 pp.)

9934—INDIA—The Biana-Lalsot Hills in Eastern Rajputana. A. M. Heron. (Rec., Geol. Surv. of India, Vol. XLVIII, Part 4, 1917; 23 pp.)

9935—LATERITE—On the Origin of the Laterite of Seoni, Central Provinces. R. C. Burton. (Rec., Geol. Surv. of India, Vol. XLVIII, Part 4, 1917; 14 pp.)

9936—MEXICO—Bibliografia Geologica y Minera de la Republica Mexicana, 1915-1918. Rafael Aguilar y Santillan. (Bol. Minero, Mar. and Apr., 1918; 14 pp.)

9937—NEW MEXICO—Geologic Structure of Sierra del Oro, in New Mexico. Chas. R. Keyes. (Eng. and Min. Journ., Sept. 14, 1918; 1 p., illus.) 20c.

9938—WESTERN AUSTRALIA—Recent Earth Tremors in Western Australia. Inter-Action of Geological Causes and Mining Operations. A. Montgomery. (Chem., Eng. and Min. Rev., July 5, 1918; 3 pp.) 40c.

MINING—GENERAL

9939—ACCIDENT PREVENTION—Progress in Accident Prevention. (Eng. and Min. Journ., Sept. 14, 1918; 1¼ pp.) 20c.

9940—ACCIDENTS—Coal-Mine Fatalities in the United States, January to May, 1918. Albert H. Fay. (U. S. Bureau of Mines, 1918; 5 pamphlets; 115 pp.)

9941—BLASTING METHODS at Ajo. S. U. Champe. (Min. and Sci. Press, July 13, 1918; 2¼ pp., illus.) 20c.

9942—BRITISH COLUMBIA—Mining in Kootenay, B. C. E. Jacobs. (Can. Min. Journ., July 15, 1918; 2¼ pp.) 20c.

9943—BURMA—The Material Resources of Burma. Harvey Adamson. (Bull. Imp. Inst., Vol. XVI, No. 1, Jan., Mar., 1918; 39½ pp., illus.) Brief enumeration of commercial products, agricultural and mineral illustrated by map.

9944—CEMENTATION PROCESS Applied to Mining (Francois System.) A. H. Krynauw. (Journ. Chem., Met. and Min. Soc. of S. Afr., May, 1918 12 pp., illus.) 60c.

9945—COLORADO—War Minerals of Colorado. A. H. Hubbell. (Eng. and Min. Journ., Aug. 31, 1918; 2½ pp.) 20c.

9946—DUST—The Estimation of Injurious Dust in Mine Air by the Kotze Konimeter. John Innes. (Journ. Chem., Met. and Min. Soc. of So. Afr., May, 1918; 7½ pp.) Discussion of article previously indexed. 60c.

9947—EXPLOSIVE—Sengite: A New Explosive. J. P. Udal. (So. Afr. Journ. of Ind., July, 1918; 2 pp.)

9948—EXPLOSIVES—Handling and Storing of Explosives. Arthur La Motte. (Eng. and Min. Journ., Sept. 14, 1918; 5¾ pp.) 20c. Paper before Seventh Annual Congress of the National Safety "La Suriana." Distrito de Aldama, Estado de Guerrero. Theo-

9949—HOISTING With Steel Cables. Ernest Levy. (Min. and Sci. Press, July 6, 1918; 1 p.) 20c.

9950—MEXICO—Los Criaderos Minerales de "Campo Morado" y "La Suriana," Distrito de Aldama, Estado de Guerrero. Theodore Flores. (Bol. Minero, Mar. and Apr., 1918; 3 pp.)

9951—MEXICO—Visita Practicada a Las Negociaciones Mineras, Fundiciones y Plantas Metalurgicas del Estado de Nuevo Leon. Jesus Ibarra. (Bol. Minero, Mar. and Apr., 1918; 24 pp.)

9952—MINING METHOD—Method of Mining Pillars at the Fortuna Mine of the Braden Copper Co., Chile. Chas. Hollister. (Eng. and Min. Journ., Sept. 14, 1918; 2 pp., illus.) 20c.

9953—SHAFT—The Repair of a Circular Shaft of Small Diameter. Stewart Chambers. (Trans., Min. Inst. of Scotland, June, 1918; 6½ pp.)

9954—SHAFT PILLAR—Notes on the Removal of a Vertical Shaft Pillar. J. Chilton. (Journ. Chem., Met. and Min. Soc. of S. Afr., June, 1918; 4¼ pp., illus.) 60c.

9955—SIGNAL SYSTEM—Anaconda Company's Bell and Buzzer Signal System. R. H. Richards. (Eng. and Min. Journ., Sept. 7, 1918; 1 p., illus.) 20c.

9956—TIMBER SET—A New Timber Set for Inclined Shafts. James E. Harding. (Eng. and Min. Journ., Sept. 7, 1918; 1¼ pp., illus.) 20c.

9957—WATER SUPPLY—Filtered Water for Industrial Use. Harold C. Stevens. (Iron Tr. Rev., Aug. 29, 1918; 3 pp., illus.)

FLOTATION

(See also "Lead and Zinc")

9958—APPARATUS—The "Little" Janney Mechanical Flotation Machine. Will C. Higgins. (Salt Lake Min. Rev., Aug. 15, 1918; 3 pp., illus.) 20c.

9959—ADDITION AGENTS—The Effect of Addition Agents in Flotation. Martin Harmon Thornberry and Horace Tharp Mann. (Vol. IV, No. 2, Bull. Mo. School of Mines, Nov., 1917; 48 pp., illus.)

9960—RUTH FLOTATION MACHINE, The. Arthur J. Hoskin. (Min. and Sci. Press, July 27, 1918; 2¾ pp., illus.) 20c.

ORE DRESSING—GENERAL

9961—CRUSHING—Grinding Ore in Ball Mills. Discussion of article by Algernon Del Mar. (Eng. and Min. Journ., Sept. 7, 1918; 1¼ pp.) 20c.

9962—ELEVATOR-BUCKET DISCHARGE, Automatic. H. M. Schleicher. (Eng. and Min. Journ., Sept. 14, 1918; 1 p., illus.) 20c.

METALLURGY—GENERAL

9963—AËROPLANE CONSTRUCTION—The Metallography and Heat Treatment of Metals Used in Aëroplane Construction. F. Grotts. (Chem. and Met. Eng., Aug. 1, 15, and Sept. 1, 1918; 20 pp., illus.) First three of a series of articles dealing with cast iron, steel, aluminum, copper, bronze and brass; typical examples of investigations of aëroplane parts, with microphotographs and results of physical and chemical tests.

9964—ALLOYS—The Constitution and Influence of a Cored Dendritic Structure in Alloys. O. Smalley. (Journ. Soc. of Chem. Ind., July 15, 1918; 10½ pp., illus.)

9965—BABBITT—Notes on Babbitt and Babbitted Bearings. Jesse L. Jones. (Bull. A.I.M.E., Aug., 1918; 7 pp., illus.) 40c.

9966—BRASS—The Influence of Small Quantities of Some Metallic Elements on the Mechanical Properties of Brass. E. Millington. (Chem. Ind., May 31, 1918; 5½ pp., illus.)

9967—CHIMNEYS—Standard Safety Ladder for Tall Chimneys. Geo. M. Douglass. (Eng. and Min. Journ., Sept. 14, 1918; ½ p., illus.) 20c.

9968—ELECTRODES—The Manufacture of Carbon Electrodes for Electrometallurgical Purposes. (Chem. and Met. Eng., Aug. 15, 1918; 6 pp., illus.) Trans. from "Stahl u. Eisen," Vol. 32, 1912.

FUELS

(See also "Petroleum and Natural Gas")

9973—CALORIMETER—A Convenient Multiple-Unit Calorimeter Installation. J. D. Davis and E. L. Wallace. (Tech Paper 91, U. S. Bureau of Mines, 1918; 48 pp., illus.)

9974—CALORIMETER EFFICIENCY, Some Points Regarding. Walter P. White. (Journ. Soc. Chem. Ind., July 15, 1918; 8 pp.)

9975—CARBONISATION—Aspects of the Low Temperature Carbonisation of Coal. Edgar C. Evans. (Journ. Soc. of Chem. Ind., July 31, 1918; 8½ pp.)

9976—COAL—Monograph on the Constitution of Coal. Marie C. Stopes and R. V. Wheeler. (Dept. of Scientific and Ind. Research of Great Britain, 1918; 58 pp., illus.) Based on paper read before the London Section of the Society of Chemical Industry.

9977—COAL SAVING by the Scientific Control of Steam Boiler plants. D. Brownlie. (Reprint from Engineering, July 12 and 19, 1918; 16 pp.)

Personal

Have You Contributed to the Association of the 27th Engineers?

L. F. S. Holland has been in Mexico City and left there about Oct. 1.

J. B. Tyrrell is visiting some parts of Newfoundland that are but imperfectly known.

Olaf P. Jenkins has been appointed to the staff of the Arizona Bureau of Mines as geologist.

D. C. Jackling has been elected president of the Butte & Superior Mining Co., succeeding the late N. Bruce MacKelvie.

J. C. Gwillem has resigned as professor of mining and ore dressing in Queen's University, Kingston, Ont., on account of ill-health.

R. B. Watson recently visited the Glencoe oil field, in western Ontario, and examined several properties on behalf of E. P. Earle, of New York.

John Kiddie, mine superintendent at Morenci, Ariz., for the Arizona Copper Co., is back at his post from a month's vacation spent in southern California.

Howard F. Wierum, general manager of the American Mineral Production Co., at Valley, Washington, is in New York in connection with business for his company.

L. H. Goodwin, with the firm of Rogers, Mayer & Ball, has returned to New York from a month's examination work in the Southwest and is leaving for similar work in Nevada.

Archiebald C. H. Gerhardi, who resigned last March as manager of the Wall Street Copper Co.'s mine at Luning, Nev., to enlist in the Canadian Engineers, has just received a commission.

Julius Kruttschnitt, Jr., of Tucson, Ariz., general manager in Arizona for the American Smelting and Refining Co., has been appointed as an advisor to the southern Arizona district exemption board.

Arthur Notman, of Bisbee, Ariz., assistant superintendent of mines, Copper Queen branch of the Phelps Dodge Corporation, has taken an examination at Camp Cody for entrance to the Engineers' Corps.

Arthur J. Bensusan, superintendent at the mines of the Ouro Preto Gold Mines of Brazil, Ltd., at Passagem, Minas Geraes, Brazil, is at the Hotel Belmont in New York. He is on his way back to Brazil from England.

A. E. Drucker has joined the firm of Howard, Morinni & Co., Inc., industrial engineers, 111 Broadway, New York, and 106 Boulevard Haussmann, Paris, as manager of their chemical and metallurgical department.

J. W. Rawlins and **J. C. Nichols,** general manager and mine superintendent, respectively, of the International Nickel Co. of Copper Cliff, Ont., recently visited Jerome, Ariz., where they showed especial interest in the new United Verde Extension smeltery.

M. E. Cassidy, of Bisbee, Ariz., for several years chief claim agent for the Copper Queen Consolidated Mining Co., has been commissioned a captain in the U. S. Army, and assigned to Camp Cody, where he will be adjutant of one of the regiments being organized there.

A. L. Dowdell, formerly superintendent of the cyanide plant of the Empire Mines and Investment Co., at Grass Valley, Calif., is now in France with the Signal Corps. **Elliott Downing,** formerly surveyor for the same company, is a lieutenant of engineers and also in France.

Thomas W. Fitzgerald, for four years head of the University of Arizona electrical engineering department, has resigned to take charge of the electrical equipment of the Ray Consolidated Copper Co., at Hayden, and to serve as consulting engineer in the same division at Ray.

Morril B. Spaulding, recently superintendent of maintenance, Chester Shipbuilding Co., Ltd., at Chester, Penn., has been appointed resident engineer, division of shipyard plants of the Emergency Fleet Corporation, and has been assigned to the same plant at Chester.

Richard H. Vail, formerly on the editorial staff of the "Journal," has been commissioned a captain in the technical division of the Chemical Warfare Service and expects to be ordered to France soon for service with the American Expeditionary Forces. For the last seven months Captain Vail has been engaged in technical work in the Ordnance Department at Washington.

Obituary

Artemas L. Grow, a pioneer of Tombstone, Ariz., died recently at Sawtelle, Calif., aged 81 years.

Edward Woods Hunt, metallurgical engineer of New York, died in this city on Sept. 25. He was born in Chicago in 1880 and was graduated from the Sheffield Scientific School in 1901. Mr. Hunt had done much work in the Far East as well as in the western part of the United States.

William A. Hendryx, inventor of the Hendryx appliance intended for the cyanide treatment of ores, died suddenly in Allentown, Penn., on Sept. 22, aged 69 years. He was born in Seymour, Conn., and was graduated in medicine from Rush Medical College. Dr. Hendryx later became interested in mining in various parts of the world.

S. M. Rodgers, metallurgist for the American Steel and Wire Co., Pittsburgh, Penn., died at Pittsburgh on Sept. 17, aged 58 years. He was born near Wellsburg, W. Va., and was a graduate of the University of Michigan. He was a member of the American Institute of Mining Engineers, the American Iron and Steel Institute and other technical societies.

Robert Elmer Booraem died recently. He was born in Jersey City, N. J., Mar. 28, 1856, and was graduated as a mining engineer at the Columbia School of Mines in 1878. In the following year he went to Leadville, Colo., where he gained practical experience and soon became manager of the then famous Morning Star and Evening Star mines, on Carbonate Hill. During that time he befriended that interesting character, Ferdinand Van Zandt, from whom Mrs. Foote drew the hero in her famous novel, "The Led Horse Claim." Van Zandt remained only a short time in Leadville, departing thence to enter upon his adventurous career, in the course of which he acquired and developed the Bluebird mine, at Butte, Mont., which made him a very wealthy man. As soon as the great value of the Bluebird seemed to be well assured, Van Zandt, ever loyal to Booraem and mindful of the helping hand extended when it was greatly needed, sent for Booraem to come to Butte to be general manager of the Bluebird, this being in 1887. At Butte, Booraem participated in the exciting times of those days and experienced some great personal hazards, but he continued to work the mine, which paid large dividends for a good many years. When the fortunes of the mine had waned, Booraem returned to New York and lived a life of considerable retirement; but in 1911 he went West again and engaged in gold mining in Arizona and Nevada, making his home in Denver. He was a member of the University Club and St. Nicholas Society in New York, and of the Sons of the Revolution and Society of Colonial Wars.

Societies

American Peat Society held its annual meeting at the Hotel McAlpin, New York, on Sept. 25-27.

Teknik Club, of Denver, Colo., held its first dinner and meeting of the season at the Shirley Hotel on Sept. 10. A paper was read by Thomas A. Dickson, on "Blast-Furnace Smelting With Oil." Experiments and commercial tests on blast furnaces fired with oil were described in detail. It appears that the process has been successful in treating ores free from magnetite, but that this mineral presents difficulties not yet satisfactorily overcome. H. B. Lowden, of the Colorado Iron Works Co., was appointed secretary-treasurer for the ensuing year.

Association of Iron and Steel Electrical Engineers elected the following officers at its convention in Baltimore, Md., on Sept. 11-14: President, D. M. Petty, superintendent electrical department, Bethlehem Steel Co.; first vice president, B. W. Gilson, superintendent electrical department, Carnegie Steel Co., Youngstown; second vice president, H. C. Cronk, McKinney Steel Co., Cleveland; treasurer, James Farrington, La Belle Iron Works, Steubenville, Ohio; secretary, John F. Kelly, Empire Bldg., Pittsburgh; directors, E. S. Jefferies, Steel Co. of Canada, Hamilton, Ont.; G. W. Richardson, American Bridge Co., Pencoyd, Penn.; F. A. Wiley, Wisconsin Steel Co., South Chicago, Ill.; and Walter Kennedy, Pittsburgh Crucible Steel Co., Midland, Pennsylvania.

Faraday Society met in London on July 23, Sir Robert Hadfield presiding. The following three papers were presented: "Contributions to the Chemistry of Aluminum and Aluminum Alloys," by John G. A. Rhodin; "Metallography of Aluminum: Recrystallization and Grain-Growth—the Result of Deformation in the Cold Prior to Annealing," by Robert J. Anderson, of Cleveland, Ohio; "Reinforced Concrete vs. Salt Brine and Sea-Water," by Prof. H. J. M. Creighton, of Swarthmore College, Pennsylvania.

Industrial News

Electrolytic Zinc Co., has discontinued operations at its plant in Baltimore, Md., which will be dismantled.

Electric Furnace Co., of Alliance, Ohio, has secured the services of Leonard W. Egan, formerly special engineer with Wellman-Seaver-Morgan Co. and, previous to that, electrical engineer for five years with the Pittsburgh Crucible Steel Co., Midland, Pennsylvania.

W. J. Armstrong, manager of the crushing and pulverizing sales department, of the Jeffrey Manufacturing Co., Columbus, Ohio, has recently received an appointment as captain in the U. S. Army and been assigned to the Ordnance Department in Washington, D. C.

Magnesia Association of America has issued in pamphlet form a specification for "85% Magnesia" non-heat-conductmg coverings for power and heating systems, which has been compiled and indorsed by the Mellon Institute of Industrial Research, of the University of Pittsburgh.

Walworth Manufacturing Co., Boston, Mass., announces that it will discontinue making the 6-in. genuine Walworth Stillson wrench, also the manufacture of the wood-handle Stillson wrench, making only the steel handle. It has adopted a special "war finish" for its Stillson wrenches for the period of the war.

Johnson, Matthey & Co., Ltd., refiners and assayers of London, England, have conducted during 1918 an exhibition of "British Science Products," including the metals and salts of gold, silver, and the platinum group, bismuth, copper, selenium, tellurium and thorium, to show the firm's connection with these in the past, as well as the developments therein due to the war.

Wood Equipment Co., has recently purchased and equipped commodious shops, at Grand Crossing, Chicago, so as to provide greater facilities for manufacturing the pneumatic rotary dump and other mining specialties. The main offices will be at the new plant, but the company will maintain city offices in the McCormick Bldg., Chicago, as well as branch offices in New York, Pittsburgh, Knoxville and Denver.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Alloy Containing Cu, Al and Zn. Frank S. Hodson, Philadelphia, Penn. (U. S. No. 1,276,916; Aug. 27, 1918.)

Alloy Containing Ni, Zr, Al, Si, and a Metal of the Cr Group. Hugh S. Cooper, Cleveland, Ohio, assignor to the General Alloys Co. (U. S. No. 1,277,046; Aug. 27, 1918.)

Copper-Nickel Matte. Separation of Metals in. George W. Pawel, Hudson Falls, and Edward A. Rekate, Lancaster, N. Y., assignors to United States Nickel Co., New Brunswick, N. J. (U. S. No. 1,276,809; Aug. 27, 1917.)

Drill, Mining. John Arthur Kaye, Sault Ste. Marie, Ont., Canada. (U. S. No. 1,277,220; Aug. 27, 1918.)

Flotation. Frank Groch, Cobalt, Ont., Canada. (U. S. No. 1,276,753; Aug. 27, 1918.)

Flotation. Walter A. Scott, Chicago, Ill., assignor to Minerals Separation North American Corporation. (U. S. No. 1,276,974; Aug. 27, 1918.)

Hoist, Portable Electric. Samuel Edward Kalbach, Reading, Penn. (U. S. No. 1,277,218; Aug. 27, 1918.)

Editorial Correspondence

SAN FRANCISCO—Sept. 24

Comstock Northend Mines milled 496 tons of ore in the week ended Sept. 21, despite the acute labor shortage caused by the desertion of miners to the copper-mining camps. The Comstock has a record of 51 years without a labor strike, because of the well-known fact that the miners have been fairly treated and received the highest wages paid in gold-mining camps since the organization of the first miners' union at Virginia City, Gold Hill and Silver City more than half a century ago. But miners, like other workmen, want the money, and they go after it when a higher wage is offered in other camps. During the week mentioned Consolidated Virginia contributed to the milling total 306 tons, averaging $13.28 per ton; Union Consolidated, 131 tons at $10.48 and 29 tons at $6.14; Sierra Nevada, 30 tons at $13.94 per ton. The aggregate yield amounted to $6033, or an average of $12.16 per ton.

Chrome Shipments from Eureka, Humboldt County, in the second week of September totaled six carloads, or about 300 tons. Five of the cars were from Del Norte County, brought into Humboldt Bay by schooners and one car was from Horse Mountain, Humboldt County. This is the second shipment from Horse Mountain mines; another carload is waiting transportation at Essex, and a third is ready for hauling to the station. No manganese shipments were made during the week, owing to damage to roads and bridges by recent forest fires. Recent development of the old Tyson chrome mine, in Del Norte County, has disclosed sufficient ore to start motor-truck hauling for rail shipment. Large tonnage of ore has been exposed, and bunkers and hoisting machinery have been installed. A new deposit has been developed on the north fork of Smith River, in Oregon just north of the California line. The property is leased to the Northwestern Chrome Co., of Seattle, which is shipping 30 tons a day.

Production of Potash from Searles Lake deposits under development by the West End Mining Co. of Nevada is expected within the coming year, according to an announcement made by the directors of the company. In declaring a recent dividend, the directors carefully considered several matters of vital interest to the company, referring to the necessity of continued development of the Searles Lake property, which is leased from the Government. Two other items of general interest were mentioned by the directors as affecting the present dividend: The subscription of the company of $25,000 to the fourth Liberty Loan, which will make a total of $165,000 of Liberty bonds. Regarding the money received from the settlement of the suit against the Jim Butler Mining Co., the West End company is not advised how it will be treated respecting taxation. In addition to these special matters the company has acquired promising gold- and silver-mining properties in Honduras, where operations are now being started. The properties at Tonopah, the directors state, are in excellent condition, and the yield continues to meet expectations. The West End company is controlled by California men, the president, F. M. Smith, and the directors being residents of Oakland.

SALT LAKE CITY—Sept. 26

Tintic Mine Owners and lessees are protesting the state occupation tax, which practically places a double tax on mines operating under the leasing system, as both the owner and the lessees pay 3% on their net profits. Most of the mines paying the tax, which is now due, are doing so under protest. The whole matter is more or less in abeyance, however, until after the elections, when the proposed constitutional amendment has been voted on and the mining public knows better where it stands.

The Eastern Part of the Tintic District is being actively developed in an effort to find another mine like the Tintic Standard. This property operated several years without opening ore in paying quantity until a good orebody was finally opened at depth. Since then the mine has been steadily adding to reserves and at the same time increasing shipments, and is now a regular dividend payer. Neighboring properties are naturally expecting to find their ore at depth, and considerable shaft sinking is in progress. The Iron King shaft is down almost 1100 ft. and the Copper Leaf, the Apex Standard and the Eureka Lily are sinking. The shaft of the Eureka Bullion is down 825 ft., and crosscutting here has opened a vein carrying iron, with some gold and silver. It is thought that the ore horizon is considerably further down. The North Lily and the Zuma are working. Also, work on the Tintic drain tunnel, further to the southeast than the properties mentioned, is expected to give interesting information as to the possibilities of this section.

Question of Mine Taxation in this state, pending before the **Legislature, is again** coming before the public in the autumn elections, when a constitutional amendment making a radical change in the present method of taxation is proposed. Mining companies will this year, as in the past, be assessed accordng to the amount of their annual net proceeds and on their surface improvements. The new law, if passed, would tax coal mines at their full cash value, and metal mines at a multiple or submultiple of their value. It is exceedingly difficult, for obvious reasons, to place a value on a mining property, and the feeling of the industry is in favor of the law as it now stands. In accordance with procedure in this state, arguments for and against the proposed constitutional amendment are being presented in pamphlet form to the voting public. The mining men's side is being presented by Jesse Knight, one of the oldest operators in the state. The proposed new law would undoubtedly increase the burdens of taxation on the mining industry, which is already bearing its full share, and the Utah Chapter of the American Mining Congress is coöperating with operators in gathering data to combat the proposed measure.

DENVER—Sept. 25

The Tungsten Industry of Boulder County may be hard hit by the new draft, according to preliminary estimates. It appears that about 500 men registered from Boulder County, and that about 230 of these are miners from the Nederland tungsten district alone. From the Lakewood district 41 men registered. It is feared that the labor shortage already existing in the tungsten camps of Nederland, Beaver Creek, Tungsten and Lakewood will become more serious after the draft begins to operate. Ways and means of replenishing the labor supply in the tungsten fields are being discussed by interested operators. Plans are being formulated to take men from other lines of work, where they can be spared, and train them as miners. It has been suggested that many men now in clerical positions can be taught how to mine, and that their places can be filled by competent women.

Colorado School of Mines introduced military training on Sept. 8. The student Army training corps has been organized and is under the command of Lieut. H. J. Shepard, of the U. S. Army. Instructions regarding the details of organization have been received by the school from Washington. A contract between the school and the Government, covering the housing and feeding of the students,, has been signed. Plans have been completed for a mess hall to accommodate 200 students. The building will cost $1500, and construction will begin as soon as the plans arrive. All work at the school will be done in accordance with Army regulations. All members of the student Army training corps are privates in the U. S. Army in active service. They may be recommended for officers' training camps, the selection to be made on a competitive basis. All members will be required to eat in the mess hall, and will be housed in buildings on or near the campus in units of not less than 25 each. All members will receive a salary of $30 a month, and will be furnished subsistence, housing, equipment, clothing, and college expenses, except text books and supplies. Some of the men will be housed in fraternity houses, and under the direction of a non-commissioned officer. The attendance at the school has recently increased to over 200.

TUCSON, ARIZ.—Sept. 27

Deferred Classification of skilled miners, smelter and mill men and mine railroad operators was discussed here at a recent meeting of the Southern Arizona district exemption board and representatives of southern Arizona and Sonora mining companies. The latter included: From Bisbee, G. H. Dowell, of the Copper Queen, and W. B. Gohring, of the Calumet & Arizona; from Douglas, Harry Clark, of the Calumet & Arizona works; J. S. Williams, of the Moctezuma, and L. R. Budrow, of the Lucky Tiger-Combination; from Cananea, Casey Stiles, of the Cananea Consolidated; from Morenci, Milton McLean, of the Detroit Copper. The board held that the industries represented were essential, but that individual claims must be presented in each case, with affidavits from the applicant's immediate superiors. The mine managers stated their output, generally, had been only 72% of that possible during the last year, due to labor shortage. Practically no development work is being done, and all men are used on ore production. Conditions in the Mexican camps are said to be worse than in Arizona, as the men called home for the draft usually are foremen or exceptionally skilled men who can hardly be replaced.

WALLACE, IDAHO—Sept. 24

Cœur d'Alene Mine Operators are preparing to ask deferred classification for practically all employees in conformity with the announced policy of the Government to retain men employed in essential war industries. It appears that the reduced production of lead, due to the shortage of labor, has already become a matter of serious concern to the Government, and unless steps are taken to prevent the working forces being further depleted through the operation of the draft, it may become necessary for the Government to take a direct hand in providing labor for the mines. The chief lead producers of the Cœur d'Alene district in some cases have less than half of their normal force, and all are seriously handicapped by the labor shortage. The standard wage scale is $5.25 per shift of eight hours, and some of the mines are paying $5.75 as an inducement to get men.

An Investigation of the Quicksilver and antimony deposits of central Idaho has been made by Robert N. Bell, state mine inspector, who has issued a report, which covers in general the topographical and geological conditions of the district and describes in detail the development and equipment of the Fern mine, which is now producing quicksilver on a small scale. The ore is being taken from a tunnel, in which the vein has been followed 80 ft., showing a width of from one to four feet, which includes a high-grade streak of from six inches to a foot in thickness. Ore is also being extracted from a surface cut. The ore is treated in a furnace of the Johnson-McKay type, which consists of a battery of steel cylinders built into an oblong brick structure 6 ft. high, 8 ft. wide and 20 ft. long. These cylinders are 12 in. in diameter and 6 ft. long, with 4-in. inclined discharge pipes at the rear for condensing the fumes. The metallic doors of the cylinders are clamped on and sealed with a paste made of wood ash. There are 12 cylinders, each with a charge capacity of 150 lbs. of ore. A firebrick flue extends under and over this battery of retorts, and the smokestack is directly over the furnace. It requires about eight hours to run through a charge. The process is simply to heat the retorts to a red heat, which drives off the volatile metal in the form of a fume, which is condensed and precipitated in the discharge pipes at the rear of each retort and dropped into a container as metallic quicksilver, from which it is ladled out and placed in ordinary quicksilver flasks ready for shipment. To compensate for the small capacity of the plant, the ore is sorted to an average of 5%, or 100 lb. of metal to the

ton of ore, which yields a handsome profit. Other properties are described by Mr. Bell, and he regards the field one of great promise. A good wagon road is the most pressing necessity to encourage development.

BUTTE, MONT.—Sept. 26

The Attempted Strike in the Butte Mines has proved to be a failure. The men who endeavored to create trouble among the miners and shut off the production of copper made greater efforts than heretofore, but to no avail. Circulars were scattered about the roads, in the boarding houses and on the streets asking that the men quit work until six hours was declared to be a day's work, and that an agreement be made that the men be lowered and hoisted on company time and the rustling card system be abolished. At first not more than 1000 men responded to the call of the I. W. W., and, finding the call a failure, the leaders had men visit the homes of miners while they were at work and warn the wives that if their husbands went to work they would be badly handled. In addition to this, men were posted in boarding houses to intimidate the men, and also stationed at points leading to the mines for the purpose of beating persons going to work. In a few cases workmen were assaulted, but this was met by the military authorities posting numerous guards at all points taken by the miners going to and returning from work, with the result that some arrests were made and severe fines imposed so that the radical element soon ceased to interfere in a public way. The I. W. W. held a mass meeting, and after some radical speeches by leaders, a resolution was adopted calling upon the Government to take over the mines and operate them. This method was adopted only to make outsiders believe that the men had some real grievance. Federal Labor Mediator Barker has arrived in the city to make an investigation into the causes of the trouble and report to the War Labor Bureau. Mr. Barker purposes taking some time in going thoroughly into the situation from every standpoint before reporting to the board. He will not listen to any one section or class, but will investigate from an independent point of view.

TORONTO—Sept. 28.

The Reid Newfoundland Railway has established a national resources department to explore large areas of land owned by the company. J. McNeil Forbes, formerly of Montreal, has been placed in charge of the new department. During the summer promising coal and mineral deposits were discovered under his direction, and active exploration of the coal area is now being undertaken. H. B. Hatch, formerly of Porcupine, is also attached to the department.

The Construction of a Railway from the Pas to the new copper district in northern Manitoba is probable, according to the Hon. Edward Brown, provincial treasurer of Manitoba. This new district, known as the Flin Flon section, lies about 70 miles from the Hudson Bay railway, and is at the boundary of Saskatchewan and Manitoba. The two principal properties are the Flin Flon and the Mandy. The former has been extensively diamond drilled, and several million tons of ore carrying gold, silver and copper have been proved up. The ore will have to be smelted on the ground, and this will require a railway and hydro-electric development. It gives promise of being one of the largest mining undertakings in Canada. The Mandy is a smaller body, and is owned by the Tonopah Mining Co. A considerable tonnage of copper ore has been developed, and this is being mined and hauled out over the winter roads for shipment to the smelters. The railway would also open up the Beaver Lake Gold section, where there are several properties of considerable promise.

VICTORIA, B. C.—Sept. 20

Question of the Joint Administration of all minerals in the Esquimalt & Nanaimo R. R. Co.'s land holdings on Vancouver Island, with the exception of gold and silver, which alone are vested solely in the province, was taken up with Lord Shaughnessy, president of the Canadian Pacific Ry. Co., by the Hon. William Sloan, Minister of Mines, at Vancouver, B. C., on Sept. 19 with satisfactory results. Mr. Sloan found that Lord Shaughnessy agreed with the position taken by the Department of Mines and unanimously endorsed by the Legislature of British Columbia at its last session, that the present system of mineral control within the area owned by the island railway was most unsatisfactory from a public standpoint. Because of the existing dual control, the development of the mineral resources of the 3,296.9 square miles of railway land on the island was being seriously retarded, and owing to the complications likely to arise in the securing of title to minerals other than gold and silver in this section, prospectors were not inclined to go into the field and develop it. The difficulties were aggravated by the fact that where gold and silver was discovered on the island the ore usually contained other minerals. For the encouragement of prospecting in the Esquimalt & Nanaimo belt, and in the interests of the mining industry of this part of the province, it was desirable that there should be some understanding between the province and the railway company as to the development of resources known to exist but hitherto practically untouched in an economic sense.

The Mining News

ARIZONA

Cochise County

DRAGOON MOUNTAIN (Johnson)—Drifting east and west on 300 level of vertical shaft. New ore has been cut on 400 level of inclined shaft.

PEABODY (Johnson)—To resume development on extensive scale.

HILLTOP EXTENSION (Paradise)—Lead-silver ore to be shipped upon completion of new road to the mine.

Graham County

ARIZONA SYNDICATE (Geronimo)—Work started on 1500-ft. tunnel to cut vein containing copper with some gold and silver.

Greenlee County

ARIZONA COPPER (Clifton)—Copper production during August was 4,300,000 pounds.

Mohave County

TUCKAHOE (Kingman)—Shaft has reached 250 level. Hoist and compressor have been installed.

TOM REED (Oatman)—Installing new mill machinery, including crusher.

Yavapai County

CALUMET & JEROME (Jerome)—Announcement has been made of suspension of operations till after the war. Last drilling contract completed.

GRAND ISLAND (Jerome)—Development work has been suspended, after completion of 4500 ft. of drilling, until after next directors' meeting, when it is expected that sinking will be resumed on main shaft. New bunk houses are being built.

JEROME VERDE (Jerome)—Has resumed shipments to Humboldt smeltery. Mining from stopes above the 900 level in Maintop section.

UNITED VERDE (Jerome)—In August produced 7,910,000 lb. of copper. Smeltery operating at capacity.

VERDE COMBINATION (Jerome)—Drifts have been driven in both directions on a decomposed quartz vein cut by a crosscut from the 1080 station.

CALIFORNIA

Madera County

GREEN MOUNTAIN (Raymond)—Sold to W. H. Wilson, of Alameda. Development has started.

Nevada County

LABOR SHORTAGE, which has been felt by mining companies at Grass Valley and Nevada City, is at an end. Miners who left during the summer months to work at the shipyards have found living expenses higher and are returning.

KENOSHA (Grass Valley)—To be reopened by Alcalde Gold Mines Co. under management of George W. Root, of San Francisco. Formerly large producer.

EL ORO (Lake City)—Complaint lodged against manager for storing powder in old blacksmith shop without license. John M. Griffin, Federal inspector, is investigating.

Tuolumne County

DUTCH (Jamestown)—Good grade of ore developed on 2300 level. Concrete foundations for new mill nearly complete.

ALPHA (Sonora)—Recent shortage of water caused temporary shut-down of mill. Rains of past week promise good supply.

CONFIDENCE (Sonora)—New mill in operation on ore from recent development and lower levels.

SIERRA NEVADA EXPLORATION (Sonora)—Good gravel extracted in development drift to old Berry channel. J. J. Hadecker is manager.

IDAHO

Shoshone County

COPPER KING (Mullan)—Work suspended probably until end of war. Planning to build mill to treat large body of low-grade lead-zinc ore.

JACK WAITE (Murray)—Hauling lead ore by motor truck from mine to railroad at Prichard.

YUKON GOLD (Murray)—New spud, 50 ft. long, 4 ft. square and weighing 20 tons, to be delivered at dredge on Prichard Creek. Will be loaded on two heavy transfer trucks and drawn by caterpillar tractor.

KANSAS

Joplin District

MIAMI VOLUNTEER (Baxter Springs)—To build 200-ton mill. Will use, but have not purchased, tables, crushers, compressors and conveyors.

MISSOURI

Joplin District

COW CREEK (Carl Junction)—To build 200-ton mill. Need, but have not purchased, tables, crushers, compressors and conveyors. W. H. Clark is superintendent.

HEATON & HODGES (Neosho)—To build 500-ton mill. Need, but have not purchased, crushers, tables, conveyors, compressors and ore cars.

NEVADA

Esmeralda County

SILVER PEAK RAILWAY is being dismantled, and equipment will be shipped to France, it is stated. This road, 17 miles long, connected Blair with Blair Junction, on Goldfield branch of Southern Pacific Ry. Since the closing down of Pittsburg-Silver Peak company, upon which Blair depended, there has been no use for the branch.

C. O. D. (Goldfield)—Lessees mining high-grade ore in vein recently opened in winze 125 ft. below 65 level. Work being done through main Gold Bar shaft. Milling-grade ore also opened on 200, 300 and 400 levels.

FLORENCE GOLDFIELD (Goldfield)—Several lessees making good production, some in neighborhood of main shaft, and some in old Reilly lease block.

RED HILL FLORENCE (Goldfield)—Drifting from winze 50 ft. below 400 level has opened vein of ore. Stoping on 400, 450 and 500 levels. Development on 600 level will be started as soon as shaft station is enlarged.

Humbolt County

SILVER DISCOVERY in old Rileyville district, 30 miles west of Unionville, has been made recently. Another silver discovery reported made on Duffner property, in Spring Hill mining district, 10 miles from Antelope station on Western Pacific Railway.

TWO NEW TUNGSTEN MILLS are being built at new camp of Tungsten, 30 miles west of Winnemucca, and nine miles from Mill City. Companies building are Nevada-Humboldt Tungsten Co., a subsidiary of Tungsten Products Co., and Pacific Tungsten Co., with which W. J. Loring is associated. Former company building 100-ton plant, and latter 125-ton plant.

SUNSET MINING AND DEVELOPMENT (Unionville)—Has taken over Arizona property, and preparing to reopen. Machinery for flotation plant now being hauled in. Development work progressing with satisfactory results, and, in addition to ore developed, dumps contain considerable tonnage of commercial-grade ore.

Lincoln County

PRINCE CONSOLIDATED (Pioche)—Has secured adjoining manganese property; previous development has opened large tonnage of commercial ore.

Lyon County

NEVADA-DOUGLAS (Ludwig)—Hoisting and pumping equipment being installed on 800-ft. level. Winze to be sunk to open ore below big caved stope extending from 800 to 700 level. Buildings and equipment of copper-leaching plant, built four years ago, and which did not prove to be a metallurgical or economical success, being sold f.o.b. Wabuska, Nevada. Equipment consists of crushing machinery, elevators, belt conveyors, Oliver filters, digestors, acid proof tanks and pipes.

McCONNELL (Mason)—Shipping regularly to smeltery. Lessees opening carbonate ore at surface on north end of group.

MINNESOTA-NEVADA (Wabuska)—Shipments of high-grade copper ore being made.

BLUESTONE MINING AND SMELTING (Yerington)—Regular shipments of copper carbonate ore made to Thompson smeltery, and mill treating 300 tons daily of copper sulphide ore. Janney flotation machines used entirely in mill, slimes being dewatered on Oliver filter. Number of cottages being built to accommodate workmen.

Mineral County

CANDELARIA MINES (Candelaria)—Has acquired large acreage covering several early-day producers, and is planning considerable development. Three veins, opened by tunnel in Lucky Hill at depth of 220 ft., show some milling-grade ore. Old dumps of camps contain large tonnage of low-grade silver ore, which it is now believed can be milled at a profit.

Nye County

WHITE CAPS (Manhattan)—Three shifts sinking main shaft, now below 500 level. Stoping on 300, 400 and 500 levels, and milling plant operating to capacity.

CASH BOY (Tonopah)—Main shaft to be sunk 155 ft. deeper than 1435 level to facilitate extraction of ore below.

JIM BUTLER TONOPAH (Tonopah)—Net earnings for August were $29,813.

MONARCH PITTSBURGH (Tonopah)—Crosscutting south on 600 level to be continued to Ohio vein.

RESCUE EULA (Tonopah)—Raising from 1150 level to cut ore on 1050 level.

TONOPAH BELMONT (Tonopah)—Milling plant now treating ore from Tonopah Mining Co. and Jim Butler in addition to its own ore.

TONOPAH DIVIDE (Tonopah)—Northwest drift on 370 level being advanced in milling-grade ore. Southeast drift discontinued until surface plant in operation, as material cannot be handled. Shaft will be sunk to water level at once.

TONOPAH MINING (Tonopah)—Large tonnage low-grade dump material being shipped to milling plant at Millers.

WEST END CONSOLIDATED (Tonopah)—New hoisting machinery being installed, larger ore pocket being built below 900 level of No. 2 shaft and station on 800 level to be enlarged to accommodate double tracks.

Storey County

COMBINATION SHAFT (Virginia City)—Unwatered to point 140 ft. below Sutro tunnel. New pumps will be installed and unwatering continued.

CONSOLIDATED VIRGINIA (Virginia City)—Ore being hoisted during development work on 1800, 2000 and 2200 levels; best ore mined from raise above 2200 level.

HALE & NORCROSS (Virginia City)—Extensive development work will be done in near future. Control acquired by H. L. Slosson and associates.

SIERRA NEVADA (Virginia City)—Drifting north on 2500 level in low-grade quartz; also raising to 2400 level.

UNION CONSOLIDATED (Virginia City)—South drift on 2500 level in low-grade quartz; better grade ore being stoped above level.

White Pine County

CONSOLIDATED COPPER MINES (Kimberly)—Developing on 1100 and 1200 levels. Crosscut being driven on 1300 level to explore downward continuation of ore from levels above. Power line connecting Kimberly with the Nevada Consolidated main transmission line has been completed.

NEVADA CONSOLIDATED (McGill)—Copper production during August was 6,500,000 pounds.

LUCKY BOY (Osceola)—Development progressing with satisfactory results, and gold-silver-lead ore is being opened up. New shaft sunk 125 ft. in ore. Better grade ore to be shipped, and rest stockpiled until jigging plant is built. Mace Clays is manager.

NEW JERSEY

Morris County

SCRUB OAK (Hibernia)—Operating at full capacity and supplying iron ore to Wharton Steel Co.'s furnaces.

NEW MEXICO

Grant County

CHINO COPPER (Hurley)—August output of copper was 5,065,818 pounds.

REPUBLIC (Hurley)—Recently installed 350-ft. compressor. Mining zinc sulphide ore. Dave Ball is superintendent.

BONNEY (Lordsburg)—Lease of Lawrence Mining Co. has expired. Property will be operated by owners, Bonney Mining Co. James P. Porteus is general superintendent.

LAST CHANCE (Lordsburg)—Work on new mill progressing. Mining force increased to 25 men. J. Shotwell is superintendent.

Luna County

EL PASO (Cooks Peak)—Shipping two cars of lead carbonates per week to El Paso smeltery. T. S. Grover is superintendent.

LIBERTY MANGANESE (Deming)—Have car of high-grade manganese ready to ship. Fred Kohlmeyer is superintendent.

NEW YORK

Sullivan County

ST. NICHOLAS ZINC (Summitville)—Has been leased on a royalty basis. Changes and improvements are being made in the mill.

OKLAHOMA

Joplin District

CONSOLIDATED (Commerce)—Has taken over Emma Gordon mine.

ST. LOUIS LEAD & ZINC (Miami)—To move new mill near Quapaw, to Jefferson mine, south of St. Louis.

MIAMI WONDER (Picher)—New 300-ton mill in operation.

AURORA (Quapaw)—New 200-ton mill in operation.

SCOTT-EAGLE (Quapaw)—Operating after several weeks' shut-down. R. P. Sharp is manager.

TEXAS

El Paso County

MAGNESITE DEPOSITS near El Paso have been optioned to the Magnesite Products Corporation, of New York.

UTAH

Juab County

TINTIC SHIPMENTS for week ended Sept. 21 amounted to 150 cars, although below average of shipments in the past.

CHIEF CONSOLIDATED (Eureka)—New shaft down 211 ft. Daily progress averaging 7 feet.

Salt Lake County

ALTA CONSOLIDATED (Alta)—Shipping ore from three stopes and developing iron ore carrying silver and copper.

MICHIGAN-UTAH (Alta)—Pipe line for air to Lost tunnel to be extended and power drill installed.

WASATCH MINES (Alta)—Drain and operating tunnel in 2750 feet.

Summit County

PARK CITY SHIPMENTS for week ended Sept. 21 amounted to 1800 tons, as compared with 2083 tons week preceding and 1789 tons week before that.

ONTARIO SILVER (Park City)—Shipments coming chiefly from new stopes between 1500 and 1800 levels.

Tooele County

WESTERN UTAH COPPER (Gold Hill)—Shipping only lead-silver ores at rate of 100 tons daily. Greater part of this coming from main workings at Gold Hill. Shaft at Yellow Hammer property down 100 feet.

SILVER QUEEN LEASING (Wendover)—Fluorspar being developed. First car shipped. Also good showing of silver-copper ore.

VIRGINIA

Smyth County

MANGANESE PRODUCTS (Sugar Grove)—Considering installation of additional trackage and equipment to carry on extensive development of open pit during winter. Company has complete washing plant. Stephen Robinson, Jr., is president; H. H. Green is superintendent of mines.

WISCONSIN

Zinc-Lead District

RAISBECK MINING (Cuba City)—New organization formed to take over and operate the old Raisbeck, formerly operated by the C. S. H. Mining Co. James Drought and others, of Milwaukee, are interested.

ZINC HILL (Cuba City)—Sinking new shaft at the mill site, near Elmo, where the Springhill mill equipment has just been assembled. Charles Wolfe is manager.

WICKS MINING (Mineral Point)—Prospecting Senator lease near Rewey.

CANADA

Manitoba

EMPRESS CLAIMS (Falcon Lake)—An initial shipment of scheelite ore has been made. Camps have been completed and preparations made for work during the winter.

Ontario

PARAGON-HITCHCOCK (Elk Lake)—Two properties have been consolidated and arrangements are being made to develop.

DOME (Porcupine)—Contract let to drive raise from the 800 level to the 700 level, connecting workings with other parts of the mine.

CHAMBERS FERLAND (Cobalt)—Mine is closing down. Small amount of ore next to the Nipissing line still to be extracted, but this will be left until the latter has been mined.

COBALT PROVINCIAL (Cobalt)—Will be reopened as soon as new electric pumps have been installed. Flotation equipment has been ordered, which will give the plant a capacity of about 50 tons per day.

LA ROSE (Cobalt)—Contract to haul ore from Violet property to concentrator has been let.

PITTSBURG-LORRAIN (South Lorrain)—Operating old Currie property and using mill of the Wettlaufer mine, to which has been added a small flotation equipment.

KIRKLAND PORPHYRY (Kirkland Lake)—Minority interests in the Orr Gold Mines are opposing the sale of the two northerly lots of the company to the Kirkland Porphyry, and have secured an injunction

MONTREAL-KIRKLAND (Kirkland Lake)—Shaft down 50 ft. to be continued to 100 level and another shaft sunk on a second vein.

TECK HUGHES (Kirkland Lake)—To reopen and proceed with development work. Eventually a new mill will be built.

TOUGH OAKES (Kirkland Lake)—Activity resumed. Dewatering workings and cleaning up the mill.

WRIGHT HARGRAVES (Kirkland Lake)—To proceed with construction of 150-ton cyanide mill.

MEXICO

Baja California

COMPAGNIE DU BOLEO (Santa Rosalia)—Copper production during August was 1,730,400 lb. Copper ore averaged 3.60% copper.

CHILE

CHILE COPPER (Chuquicamata)—During August produced 8,496,000 lb. of copper.

The Market Report

SILVER AND STERLING EXCHANGE

Sept.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Sept. Oct.	Sterling Exchange	Silver New York, Cents	Silver London, Pence
26	4.7550	101⅛	49⅛	30	4.7550	101⅛	49⅛
27	4.7550	101⅛	49⅛	1	4.7550	101⅛	49⅛
28	4.7550	101⅛	49⅛	2	4.7550	101⅛	49⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Sept. Oct.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
26	*26	†	8.05	7.75	8.85 @8.95
27	*26	†	8.05	7.75	8.85 @8.95
28	*26	†	8.05	7.75	8.85 @8.95
30	*26	†	8.05	7.75	8.80 @8.90
1	*26	†	8.05	7.75	8.75 @8.85
2	*26	†	8.05	7.75	8.75 @8.85

* Price fixed by agreement between American copper producers and the U. S. Government, according to official statement for publication on Friday, September 21, 1917, and July 2, 1918.

† No market.

The above quotations (except as to copper, the price for which has been fixed by agreement between American copper producers and the U. S. Government, wherein there is no free market) are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars.

We quote electrolytic cathodes at 0.05 to 0.10c below the price of wirebars, cakes and ingots.

Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 35c. per 100 lb. above St. Louis.

LONDON

Sept. Oct.	Copper Standard Spot	Copper Standard 3 M.	Copper Electrolytic	Tin Spot	Tin 3 M.	Lead Spot	Lead 3 M.	Zinc Spot
26	122	122	137	337	337	29½	28½	54
27	122	122	137	337½	337½	29½	28½	54
28	...	...	...	...	...	...	...	...
30	122	122	137	337½	337½	29½	28½	54
1	122	122	137	337½	337½	29½	28½	54
2	122	122	137	337½	337½	29½	28½	54

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at $4.7515: £29½ = 6.2576c.; £54 = 11.4545c.; £110 = 23.3333c.; £125 = 26.5151c.; £260 = 55.1513c.; £280 = 59.3937c.; £300 = 63.6362c. Variations, £1 = 0.2121205c.

Metal Markets

NEW YORK—Oct. 2, 1918

There have been no features of especial interest except the further weakness in zinc.

Copper—As usual, there is nothing special to report. There were conferences in New York this week between representatives of the War Industries Board and the manufacturers over the matter of contracts which were disturbed by the change of price on July 2. This controversy is not yet settled in so far as the manufacturers are concerned, but their complaint seems to be against the War Industries Board rather than against the producers.

The supply of copper is becoming scarcer than ever, the Government ordering out large quantities. Practically no copper is left for ordinary industrial consumption.

There is no particular interest in the forthcoming meeting between the producers and the price-fixing committee. Nobody among the producers expects that the price will be changed. Everything has settled down on the policy of curtailed production and curtailed consumption. The labor situation has reached such a stage that producers probably could not now increase production anyhow.

Copper Sheets—The base price of copper sheets remains at 35½c. per lb. Copper wire is quoted at 29½ to 30c. per lb. f.o.b. mill, carload lots, subject to any change in the price of copper.

Tin—The control and allotment of this metal have become similar to what prevail in the cases of copper and lead, except that no price has yet been made. It seems as if some definite statement ought to be made. The War Industries Board has issued a questionnaire to everybody handling tin, calling for a statement of business from June 1 to Oct. 1, replies returnable not later than Oct. 15. In the meanwhile, there seems to be no interference with imports that are arriving. Banka and Chinese tins are quoted nominally at 82@84c., but it is doubtful whether there would be either buyers or sellers for any quantities worth mentioning.

The London tin quotations for Sept. 25, which had not been received at the time of going to press with the Sept. 28 issue, are: Spot, 338; 3 mo. 338.

Lead—There is no change in the situation, which remains as tight as ever.

Zinc—The market became weaker from day to day on relatively small business. There were plenty of sellers on comparatively small quantities, but there was no pressure to sell by interests which might make large offerings.

Zinc Sheets—Unchanged at $15 per 100 lb. less usual trade discounts and extras as per list of Feb. 4.

Other Metals

Aluminum—Unchanged at 33c. per lb.

Antimony—The situation became stronger without there being much change in price. We quote spot at 14½@14¾c., but there were more buyers than sellers at those prices. Some considerable speculative buying was reported, and there was talk about prospective Government buying. It is the general expectation in the market that upon real buying by consumers the price will advance. Nobody would quote antimony for shipment. The Chinese market is above the level of the price here and is very strong.

Bismuth—Metal of the highest purity for pharmaceutical use is quoted at $3.50 per lb. for wholesale lots—500 lb. and over.

Cadmium—This metal is quoted at $1.50 @ $2 per pound.

Nickel—Market quotation: Ingot, 40c.; shot, 43c.; electrolytic, 45c. per pound.

Quicksilver—New York became a little easier, owing to some considerable arrivals. We quote $125@130. San Francisco reports, by telegraph, $120, strong.

Silver and Platinum

Silver—London and New York price of bar silver steady and unchanged, 49⅛d. and $1.01⅛ for 999 fine. China exchanges are still disturbed by the lack of consignments to that quarter. It is expected, however, that the British government will give this matter its attention. Shipments to London for the week ended Sept. 28 were 500,000 ounces.

Mexican dollars at New York: Sept. 26, 78; Sept. 27, 78; Sept. 28, 78; Sept. 30, 78; Oct. 1, 78; Oct. 2, 78.

Platinum, Palladium and Iridium—Prices fixed at $105, $135 and $175, respectively.

Zinc and Lead Ore Markets

Joplin, Mo., Sept. 28—Blende, per ton, high, $78; basis 60% zinc, premium, $75; Class B, $65@60; Prime Western, $55; calamine, basis 40% zinc, $40@35. Average selling prices: blende, $54.95; calamine, $39.67; all zinc ores, $54.79.

Lead, high, $104.80; basis 80% lead, $103@100; average selling price, all grades of lead, $100.55 per ton.

Shipments the week: Blende, 10,163; calamine, 765; lead 1481 tons. Value, all ores the week, $748,960.

Shipments nine months: Blende, 360,680; calamine, 16,146, lead, 56,614 tons. Value all ores nine months, $24,363,550.

The return this week of one smelting agency to the market, after several weeks' rest, with an order for 5000 tons, set the basis price of Prime Western grades of blende up to $55 on all classifications.

Platteville, Wis., Sept. 28.—Blende, basis 60% zinc, highest settlement price reported, $75.80. Base price for premium grade, $75. Base price for high-lead blende, $52 to $53 per ton. Lead ore, basis 80% lead, $97 per ton. Shipments reported for the week were 2367 tons blende, 145 tons galena, and 463 tons sulphur ore. For the year to date the figures are 96,678 tons blende, 5928 tons galena and 35,751 tons sulphur ore. During the week 2509 tons blende was shipped to separating plants.

Other Ores

Chrome Ore—Charles Hardy reports that considerable offerings come daily from the West and considers that the bottom has dropped out of the market, few of the Eastern buyers being willing to take chances at the present time.

Manganese Ore—Unchanged.

For the schedule of manganese ore prices refer to page 1053 of our issue of June 8, 1918.

Molybdenum Ore—There seems to be a good deal of talk about this mineral, but not much business. It is quoted nominally at $1.25, but we hear of no sales. Undoubtedly, it could be bought at $1.15 in large quantities. We quote $1.15.

Pyrites—Prices of domestic pyrites are no longer quotable, as they are determined by negotiation between buyer and seller. Some quotations are 30 to 35c. per unit, according to location.

Tungsten—Market remains active. High-grade scheelite commands a premium of 50c. per unit; scheelite free from impurity is almost unobtainable. High-grade wolframite $24@24.50; low-grade ores $19@24 per unit, according to amount and kind of impurity.

Iron Trade Review

PITTSBURGH—Oct. 1

The revision in iron-ore and pig-iron prices for the fourth quarter of the year seems to have satisfied producers fairly well. The integrated-steel producers are not affected and had presented no complaint. Class 3 steel works—those that buy their pig iron—will receive no more for their steel products, but will have to pay more for pig iron, and are not well satisfied, but it is not definitely shown that any will fail to make moderately large profits.

The price readjustments do not amount to much in actual money value compared with the total amount of iron and steel business under control. There has been no important change in finished-steel prices, and as the output is over 3,000,000 net tons a month, and the average price about $75, there is an annual turnover of nearly $3,000,000,000, practically unchanged. The advances in iron ore and pig iron, on the tonnage that is actually sold, total less

than $15,000,000 a year. Roughly speaking, three-fourths of the Lake Superior iron ore and three-fourths of the pig iron are produced by those who consume it. The Lake Superior iron ore advance is 25c. per ton.

Apart from the price revision of the War Industries Board, for the fourth quarter, a new batch of prices has been announced by the Institute, effecting numerous small changes. Cut nails are advanced from $4 to $5, and the jobbers' margin on both cut and wire nails is reduced from $1 to 50c. a keg. Cold-rolled strip steel is made f.o.b. Pittsburgh, instead of delivered, making an advance of 15c. to 31c. per 100 pounds.

Pig-iron and steel production is increasing, partly by reason of efforts to produce better coke and partly through the weather becoming favorable. The War Industries Board continues its work of endeavoring to conserve steel, by making agreements with commercial consumers producing wares necessary for the civilian population whereby their operations will be limited. In many cases operations in the last four months of this year are to be 50% of the operations in the same period last year, the operations to include the filling of Government and Allied orders. At the same time, the steel demands of the war program are being studied to find possible cases in which the supply of steel can be decreased without decreasing the war operations. The only finishing line for which a large increase in the supply of raw steel is definitely desired is rails, and it is understood rail production is being increased from 65,000 tons to 85,000 tons a week, about two-thirds of the tonnage being for domestic roads and one-third for operations abroad, partly by France and partly by the A. E. F. Prospects are that the apparent gap between steel requirements and steel supply, lately estimated at possibly 5,000,000 net tons for the current half year, will be greatly reduced. It has not been shown that any war activity has thus far suffered from the lack of a large tonnage of steel, and the pressure for more steel has been largely a measure of safety, particularly as there might be interruptions to production in the winter. The Railroad Administration, however, seems to feel reasonably certain that there will be full service this winter, and that last winter's curtailment in steel output was due chiefly to transportation conditions.

Pig Iron—Under the former competitive system there was a Pittsburgh pig-iron market, furnaces with different freight rates equalizing under stress of competition. Now the price delivered Pittsburgh varies according to point of production. Since quotations were fixed, and until today, prices were uniform f.o.b. furnace. Now Tennessee and Virginia iron is f.o.b. Birmingham and Eastern Pennsylvania iron f.o.b. Pittsburgh, the establishment of the removed basing points giving the furnaces affected higher prices f.o.b. furnace. Prices on all grades except bessemer are advanced $1 per ton, making basis prices as follows: Foundry iron, $33; forge, $32; malleable, $33.50; basic, $33; bessemer, $35.20. Freight from Valley furnaces to Pittsburgh is $1.40 and from six detached furnaces somewhat less. Common practice is to assume the Pittsburgh market to be the Valley price plus freight. W. P. Snyder & Co. report averages for September, based on actual sales (chiefly allocations) at $32 for basic and $35.20 for bessemer, at Valley furnaces. Foundry iron was quotable at $33, Valley, throughout September.

Steel—Apart from some rearrangements in contracts for ingots, there has been nothing done in the unfinished-steel market. Billets remain quotable at $47.50, sheet bars and small billets at $51, slabs at $50 and rods at $57.

Ferroalloys—There is somewhat more activity in manganese alloys, chiefly in ferromanganese, for first half of 1919. Ferromanganese remains at $250, delivered, for 70%, and spiegeleisen at $75, furnace, for 16%. Furnaces are now quoting a $3.50 unit differential on ferromanganese above 70%. Though $3.50 appears superficially to be a lower unit price than obtains with 70% alloy at $250, it is really higher, as the buyer loses the iron the manganese displaces.

Coke—The Carnegie Steel Co. last week put in operation the seventh 64-oven battery at its Clairton byproduct plant, making 448 ovens in operation. The eighth is to start in about a fortnight, and two more by about Nov. 1, making a total of 640 ovens at the plant. Twelve additional batteries are to follow considerably later. The 448 ovens are now rated at 4550 tons of coke per day, on 19 hours' coking time and using high volatile coal from the Lower Connellsville, which gives only a 65% coke yield but produces much more sulphate of ammonia and toluol. Old basin coal would give about a 70% coke yield. Reports from furnaces now are that the quality of Connellsville coke is showing improvement as a result of the Fuel Administration's strenuous campaign for better coke quality. Connellsville coke remains at $6 for furnace and $7 for foundry, per net ton at ovens.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1916	1917	1918	1916	1917	1918
Jan.	56.775	75.630	88.702	26.960	36.682	44.356
Feb.	56.765	77.585	85.716	26.975	37.742	42.792
Mar.	57.935	73.861	88.082	27.597	36.410	43.620
April	64.415	73.875	95.346	30.662	36.963	47.215
May	74.269	74.745	99.505	35.477	37.940	48.980
June	65.024	76.971	99.500	31.060	39.065	48.875
July	62.940	79.010	99.625	30.000	40.110	48.813
Aug.	66.083	85.407	100.292	31.498	43.418	49.077
Sept	68.515	100 740	101.125	32.584	50.920	49.500
Oct.	67.855	87.332	.....	32.361	44.324	.....
Nov.	71.604	85.891	.....	34.192	43.584	.....
Dec.	75.765	85.960	.....	36.410	43.052	.....
Year.	65.661	81.417	.....	31.315	40.851	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York Electrolytic		London Standard		London Electrolytic	
	1917	1918	1917	1918	1917	1918
Jan.	28.673	23.500	131.921	110.000	142.895	125.000
Feb.	31.750	23.500	137.895	110.000	148.100	125.000
Mar.	31.481	23.500	136.750	110.000	151.000	125.000
April.	27.935	23.500	133.842	110.000	147.158	125.000
May.	28.788	23.500	130.000	110.000	142.000	125.000
June	29.962	3.500	130.000	110.000	142.000	125.000
July.	26.620	25.904	128.409	119.913	140.409	134.913
Aug.	25.380	26.000	122.391	122.000	137.000	137.000
Sept.	25.073	26.000	117.500	122.000	135.250	137.000
Oct.	23.500	.....	110.000	.....	125.000	.....
Nov.	23.500	.....	110.000	.....	125.000	.....
Dec.	23.500	.....	110.000	.....	125.000	.....
Year	27.180	.....	124.892	.....	138.401	.....

Tin	New York		London	
	1917	1918	1917	1918
January	44.175	85.500	185.813	293.227
February	51.420	92.000	198.974	311.525
March	54.388	(a)	207.443	318.875
April	55.910	(a)	220.171	329.905
May	63.173	(a)	245.114	364.217
June	62.053	(a)	242.083	331.925
July	62.570	(a)	242.181	360.347
August	62.681	(a)	243.978	380.900
September	61.542	(a)	244.038	343.905
October	61.851	.....	247.467	.....
November	74.740	.....	274.943	.....
December	87.120	.....	298.556	.....
Av. year	61.802	.....	237.563	.....

(a) No average computed.

Lead	New York		St. Louis		London	
	1917	1918	1917	1918	1917	1918
January	7.626	6.782	7.530	6.684	30.500	29.50
February	8.636	6.973	8.595	6.899	30.500	29.50
March	9.199	7.201	9.120	7.091	30.500	29.50
April	9.288	6.772	9.158	6.701	30.500	29.50
May	10.207	6.818	10.202	6.704	30.500	29.50
June	11.171	7.611	11.123	7.511	30.500	29.50
July	10.710	8.033	10.644	7.750	30.500	29.50
August	10.594	8.050	10.518	7.750	30.500	29.50
September	8.680	8.050	8.611	7.750	30.500	29.50
October	6.710	.....	6.650	.....	30.500	.....
November	6.249	.....	6.187	.....	30.500	.....
December	6.375	.....	6.312	.....	30.500	.....
Year	8.787	.....	8.721	.....	30.500	.....

Spelter	New York		St. Louis		London	
	1917	1918	1917	1918	1917	1918
January	9.619	7.836	9.449	7.661	48.329	54.000
February	10.045	7.814	9.875	7.639	47.000	54.000
March	10.300	7.461	10.130	7.286	47.000	54.000
April	9.459	6.890	9.289	6.715	54.632	54.000
May	9.362	7.314	9.192	7.114	54.000	54.000
June	9.371	8.021	9.201	7.791	54.000	54.000
July	8.643	8.688	8.473	8.338	54.000	54.000
August	8.360	8.985	8.190	8.635	54.000	54.000
September	8.136	9.442	7.966	9.092	54.000	54.000
October	7.983	.....	7.813	.....	54.000	.....
November	7.847	.....	7.672	.....	54.000	.....
December	7.685	.....	7.510	.....	54.000	.....
Year	8.901	.....	8.813	.....	52.413	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Pig Iron, Pgh.	Bessemer‡		Basic‡		No. 2 Foundry	
	1917	1918	1917	1918	1917	1918
January	$35.95	$37.25	$30.95	$33.95	$30.95	$33.95
February	36.37	37.25	30.95	33.95	30.95	33.95
March	37.37	37.25	33.49	33.95	35.91	33.95
April	42.23	36.15	38.90	32.95	40.06	33.95
May	46.94	36.20	42.84	33.00	43.60	34.00
June	54.22	36.36	50.05	33.16	50.14	34.16
July	57.45	36.60	53.80	33.40	53.95	34.40
August	54.17	36.60	50.37	33.40	53.95	34.40
September	46.40	36.60	42.24	33.40	48.5	34.40
October	37.25	.....	33.95	.....	33.95	.....
November	37.25	.....	33.95	.....	33.95	.....
December	37.25	.....	33.95	.....	33.95	.....
Year	$43.57	.....	$39.62	.....	$40.83	.....

‡ As reported by W. P. Snyder & Co.

STOCK QUOTATIONS

N. Y. EXCH.†	Oct. 1
Alaska Gold M.	3
Alaska Juneau	2
Am.Sm.&Ref.,com.	77
Am. Sm. & Ref., pf.	104
Am. Sm. Sec., pf., A.	90
Am. Zinc	15
Am. Zinc, pf.	51
Anaconda	69
Batopilas Min.	1
Bethlehem Steel	78
Butte & Superior	26
Butte Cop. & Zinc	10
Cerro de Pasco	34
Chile Cop.	17
Chino	39
Colo.Fuel & Iron	45
Crucible Steel	62
Crucible Steel, pf.	89
Dome Mines	10
Federal M. & S.	10
Federal M. & S., pf.	39
Great Nor., ore ctf.	30
Greene Cananea	51
Gulf States Steel	76
Homestake	78
Inspiration Con.	55
International Nickel	30
Kennecott	33
Lackawanna Steel	80
Mexican Petrol.	116
Miami Copper	28
Nat'l Lead, com.	58
National Lead, pf.	101
Nev. Consol.	20
Ontario Min.	6
Ray Con.	23
Republic I.&S.,com.	90
Republic I. & S., pf.	100
Sloss-Sheffield	60
Tennessee C. & C.	16
U. S. Steel, com.	109
U. S. Steel, pf.	110
Utah Copper	84
Va. Iron C. & C.	71

BOSTON CURB*	Oct. 1
Alaska Mines Corp.	‡.12
Boston Ely	.70
Boston & Mont.	.45
Butte & Lon'n Dev.	.15
Calaveras	‡1
Chief Con.	3
Contact	‡.15
Corbin	.10
Cortez	.14
Crown Reserve	.15
Crystal Cop.	.45
Eagle & Blue Bell	2
First Nat. Cop.	1
Houghton Copper	.50
Intermountain	‡.05
Iron Cap	.19
Mexican Metals	.30
Mines of America	.90
Mojave Tungsten	.03
Nat. Zinc & Lead	.14
Nevada-Douglas	.42
New Baltic	.75
New Cornelia	.17
Oneco	.20
Pacific Mines	‡.35
Rex Cons.	.06
Yukon Gold	.85

SAN FRAN.*	Oct. 1
Alta	.02
Andes	.03
Best & Belcher	.01
Caledonia	.02
Challenge Con.	‡.03
Confidence	.08
Con. Virginia	.12
Gould & Curry	‡.01
Hale & Norcross	.02
Jacket-Cr. Pt.	.06
Mexican	.05
Occidental	.40
Ophir	‡.01
Overman	.01
Savage	.02
Sierra Nevada	.08
Union Con.	.18
Utah Con.	‡.01
Belmont	2.00
Jim Butler	.48
MacNamara	.25
Midway	.06
Mont.-Tonopah	.09
North Star	.03
Rescue Eula	.08
West End Con.	.95
Atlanta	.02
Booth	.03
Comb. Frac.	‡.02
Florence	.10
Jumbo Extension	.09
Kewanas	‡.02
Nevada Hills	.02
Nevada Packard	.20
Round Mountain	.16
Silver Pick	.03
White Caps	.09
Big Jim	‡.75
United Eastern	3.70

COLO. SPRINGS*	Oct. 1
Cresson Con.	4.75
Doctor Jack Pot	.03
Elkton Con.	‡.04
El Paso	.10
Gold Sovereign	‡.02
Golden Cycle	1.53
Granite	.15
Isabella	.04
Mary McKinney	.07
Portland	.80
United Gold M.	.10
Vindicator	.37

BOSTON EXCH.*	Oct. 1
Adventure	‡.60
Ahmeek	.75
Algomah	‡.15
Allouez	.49
Ariz. Com., ctfs.	15
Arnold	.20
Bingham Mines	9
Bonanza	.16
Butte-Balaklava	.35
Calumet & Ariz.	.67
Calumet & Hecla	450
Centennial	11
Copper Range	46
Daly West	2
Davis-Daly	2
East Butte	5
Franklin	9
Granby	3
Hancock	82
Hedley	5
Helvetia	‡12
Indiana	.20
Isle Royale	.60
Keweenaw	25
La Salle	.99
Mason Valley	5
Mass	2
Mayflower	3
Michigan	4
Mohawk	2
New Arcadian	2
New Idria	55
North Butte	1
North Lake	14
Ojibway	.50
Old Dominion	.75
Osceola	39
Quincy	52
St. Mary's M. L.	65
Santa Fe	46
Seneca	.60
Shannon	11
Shattuck-Ariz.	3
So. Lake	14
So. Utah	1
Superior	.12
Superior & Bost.	4
Trinity	4
Tuolumne	2
U. S. Smelting	.93
U. S. Smelt'g, pf.	44
Utah Apex	43
Utah Con.	1
Utah Metal	9
Victoria	1
Winona	2
Wolverine	1
Wyandot	22
	.50

N. Y. CURB†	Oct. 1
Big Ledge	
Butte & N. Y.	‡.75
Butte Detroit	.07
Caledonia	.46
Calumet & Jerome	.75
Can. Cop. Corpn.	2
Carlisle	‡2
Cashboy	.04
Con. Ariz. Sm.	1
Con. Coppermines	5
Emma Con.	.03
Goldfield Con.	.20
Goldfield Merger	.01
Greenmonster	‡
Hecla Min.	4
Howe Sound	4
Jerome Verde	.50
Louisiana	‡
Magma	‡32
Majestic	.18
Marsh	.03
McKinley-Dar-Sa.	.41
Milford	‡.75
Mother Lode	.34
Nixon Nevada	.34
Ohio Cop.	.87
Rawley	‡2
Ray Hercules	4
Richmond	‡.56
Rochester Mines	.33
St. Joseph Lead	14
Standard S. L.	.25
Stewart	.15
Success	‡.11
Tonopah	‡2
Tonopah Ex.	1
Tribullion	‡.12
Troy Arizona	10
United Verde Ext.	37
United Zinc	1
Utica Mines	‡.08

TORONTO*	Oct. 1
Adanac	.10
Bailey	.03
Beaver Con.	.28
Chambers Ferland	.10
Coniagas	2.50
Hargraves	.02
Kerr Lake	5.75
La Rose	43
Min. Corp. of Can.	2.25
Nipissing	8.37
Peterson Lake	.08
Temiskaming	.28
Wettlaufer-Lor.	‡.03
Davidson	‡.30
Dome Exten.	.14
Dome Lake	.13
Hollinger	4.87
McIntyre	1.37
Newray	.06
Porcu. Crown	‡.14
Teck-Hughes	.20
Vipond	.10
West Dome	.08

* Bid prices. †Closing prices. ‡ Last quotations.